



**CLEAN DEVELOPMENT MECHANISM**  
**PROJECT DESIGN DOCUMENT FORM (CDM-PDD)**  
**Version 03 - in effect as of: 28 July 2006**

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

&gt;&gt;

Title: Fatima N<sub>2</sub>O Abatement Project

|              |            |   |
|--------------|------------|---|
| Version 01   | 28/07/2011 | Webhosting  |
| Version 02   | 28/10/2011 | Respond to DOE validation findings                |
| Version 02.1 | 20/01/2012 | Respond to Request for Registration Incomplete    |
| Version 02.2 | 13/03/2012 | Respond to Request for Registration Incomplete II |

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

&gt;&gt;

Pakistan's economy is fundamentally based on agriculture. In order to encourage growth in the agriculture sector, the government of Pakistan promotes policies for preferential fertilizer manufacturing from natural gas in the country. This policy is intended to increase local fertilizer production in order to resolve the shortage of fertilizer due to insufficient local manufacture of fertilizer.

The increasing demand for fertilizer also activates and spurs the development of new and additional facilities related to fertilizer manufacturing.

Fatima Fertilizer Company Limited (hereafter "Fatima Fertilizer") is a large fertilizer company in Pakistan.

Fatima Fertilizer has constructed and commissioned a large scale fertilizer production complex including

- One ammonia plant (1,500t/day);
- One urea fertilizer plant (1,500t/day);
- One nitric acid plant (1,500t/day<sup>1</sup>, relocated from Immingham UK);
- One CAN fertilizer plant (1,400t/day);
- One NPK fertilizer plant (1,000t/day) and
- One NP fertilizer plant (1,200t/day).

<sup>1</sup> The amounts of nitric acid mentioned here and forthcoming are calculated at 100 percent of nitric acid concentration to ensure comparability of the data as the actual concentration of the weak nitric acid produced may vary during the production campaigns.



The nitric acid plant built by Uhde has been relocated from Hydro Agri/Yara limited UK as a part of a chemical complex. The nitric acid plant was relocated to Pakistan in Dec 2006 and put in operation for the first time in Pakistan in April 2010.

No destruction or abatement system has been installed for the reduction of N<sub>2</sub>O. Nitrous Oxide (N<sub>2</sub>O) is an undesired by-product of the nitric acid (HNO<sub>3</sub>) production process at the synthetic fertilizer production facility. However, N<sub>2</sub>O is not a toxic substance and is not regulated in Pakistan. Without the incentive of the proposed CDM project activity, about 1,070,000 tCO<sub>2</sub>e/year<sup>2</sup> would be continuously released to the atmosphere at the nitric acid plant of Fatima Fertilizer Company Limited.

The aim of the project activity is to reduce N<sub>2</sub>O emissions in the tail gas by installing a tertiary catalyst after the absorption unit. It is expected that the N<sub>2</sub>O abatement catalyst decomposes about 98% of the N<sub>2</sub>O with estimated factual annual emission reductions of approximately 1,050,000 tCO<sub>2</sub>e/year.

The baseline scenario would be therefore the production of nitric acid without the application of any N<sub>2</sub>O abatement facility as described above and identified in section B.4. of this PDD.

The project will contribute to the sustainable development of the area. Through this CDM project, Fatima Fertilizer will employ state-of-the-art N<sub>2</sub>O reduction and monitoring technology in order to reduce greenhouse gas emissions thus promoting sustainable development based on environmental and economic indicators. It will be directly measureable through the N<sub>2</sub>O emission reductions achieved due to the implementation of the project activity. Furthermore, Fatima Fertilizer will promote the concept of CDM which aims to spread state-of-the-art technologies to combat global climate change.

### A.3. Project participants:

| <b>Name of Party involved (*)<br/>((host) indicates a host Party)</b> | <b>Private and/or public entity(ies)<br/>project participants (*)<br/>(as applicable)</b>  | <b>Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)</b> |
|---|--|--|
| Pakistan (host)   | <b>Fatima Fertilizer Company Limited., Pakistan</b><br>[owner and operator of the nitric acid plant]   | No   |
| United Kingdom of Great Britain and Northern Ireland                  | <b>N.serve Environmental Services GmbH, Germany ("N.serve")</b><br>[Project developer]<br><b>Fatima Fertilizer Company Limited., Pakistan</b><br>[owner and operator of the nitric acid plant] | No   |

<sup>2</sup> Based on an estimated business-as-usual emissions factor of 7.00 kgN<sub>2</sub>O/tHNO<sub>3</sub> (N<sub>2</sub>O EU-average value. EC (2007): Reference document on best available techniques for the manufacture of large volume inorganic chemicals, page 131 and an annual design capacity of 495,000 tHNO<sub>3</sub>/year.

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

**A.4.1. Location of the project activity:**

>>

**A.4.1.1. Host Party(ies):**

>>

Islamic Republic of Pakistan

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

Sadiqabad/District Rahim Yar Khan/Punjab



Figure 1: Physical location of Sadiqabad, Pakistan

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

&gt;&gt;

United Sugar Mill Road, Mukhtar Garh, Sadiqabad

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

&gt;&gt;

The Fatima Fertilizer complex is located at latitude of approximately N 28°15.749' and a longitude of E 70° 1.895.

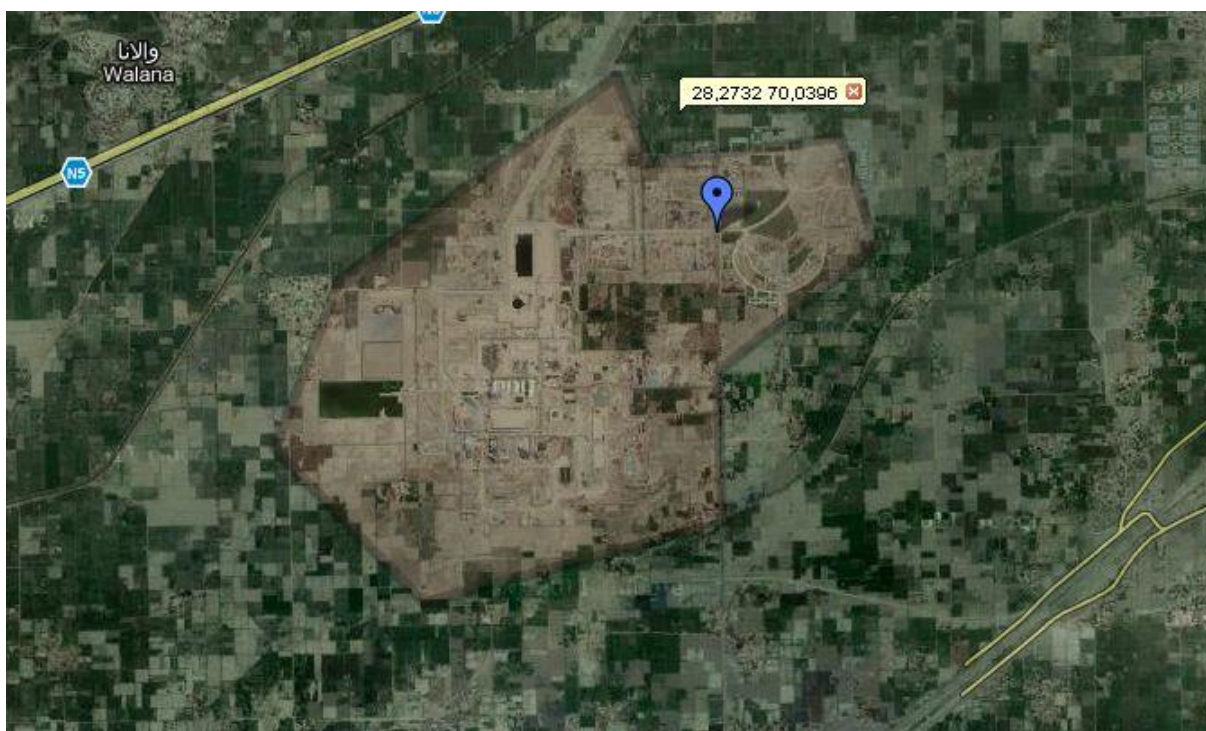


Figure 2: Physical location of the project (entrance gate to the plant) and close up

**A.4.2. Category(ies) of project activity:**

&gt;&gt;

Category 5: “Chemical industries”

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

The project activity entails the installation of:

- Tertiary N<sub>2</sub>O abatement technology,



- Specialized monitoring equipment that is installed at the tail gas stack (for further information see monitoring section in this PDD)

Accordingly, the baseline scenario was the production of nitric acid without the application of any N<sub>2</sub>O abatement facility.

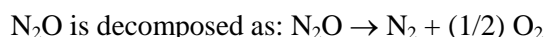
### Catalyst Technology

In the production process of nitric acid (HNO<sub>3</sub>), NO<sub>2</sub> is produced as an intermediate material from ammonia (NH<sub>3</sub>). The associated chemical reactions of oxidizing ammonia and simultaneous unwanted reactions are as follows:

- |   |   |   |  |
|---|---|---|--|
| 1. NH <sub>3</sub> + 2 O <sub>2</sub>   | → | HNO <sub>3</sub> + H <sub>2</sub> O     | (overall desirable reaction)                           |
| 2. 4 NH <sub>3</sub> + 5 O <sub>2</sub> | → | 4 NO + 6 H <sub>2</sub> O               | (desirable in the NH <sub>3</sub> oxidization process) |
| 3. 2NO + O <sub>2</sub>                 | → | 2 NO <sub>2</sub>                       | (desirable in the NO oxidization process)              |
| 4. 3 NO <sub>2</sub> + H <sub>2</sub> O | → | 2 HNO <sub>3</sub> + NO                 | (desirable in the NO <sub>2</sub> absorption process)  |
| 5. 4 NH <sub>3</sub> + 3 O <sub>2</sub> | → | 2 N <sub>2</sub> + 6 H <sub>2</sub> O   | (undesirable)  |
| 6. 4 NH <sub>3</sub> + 4 O <sub>2</sub> | → | 2 N <sub>2</sub> O + 6 H <sub>2</sub> O | (undesirable)  |
| 7. 2 NH <sub>3</sub> + 8 NO             | → | 5 N <sub>2</sub> O + 3 H <sub>2</sub> O | (undesirable)  |

Through the sixth and seventh reactions, some amount of N<sub>2</sub>O is generated in the process.

The N<sub>2</sub>O abatement technology will be installed at the tail gas downstream after the HNO<sub>3</sub> absorber and before the tail gas turbine. A tertiary catalyst reduces N<sub>2</sub>O that is formed in the primary ammonia oxidation reaction. A wide range of metals (e.g. Cu, Fe, Mn, Co and Ni) have shown to be of varied efficiency in N<sub>2</sub>O abatement catalysts. The abatement efficiency of this pelleted catalyst has been shown to be about 98% in the following reaction:



In the tertiary abatement system N<sub>2</sub>O is removed by a catalytic reduction with a hydro carbon, such as natural gas. Within the De-N<sub>2</sub>O catalyst layer the decomposition of N<sub>2</sub>O is carried out at full load of NO<sub>x</sub>, because the NO<sub>x</sub> additionally promotes the decomposition of N<sub>2</sub>O.

The applied technology is chosen because it has negligible risk to decrease HNO<sub>3</sub> production and a high expected N<sub>2</sub>O decomposition rate of around 98% of the N<sub>2</sub>O.

By introducing this technology, Fatima Fertilizer obtains a clean technology which is not yet widely commercialized.

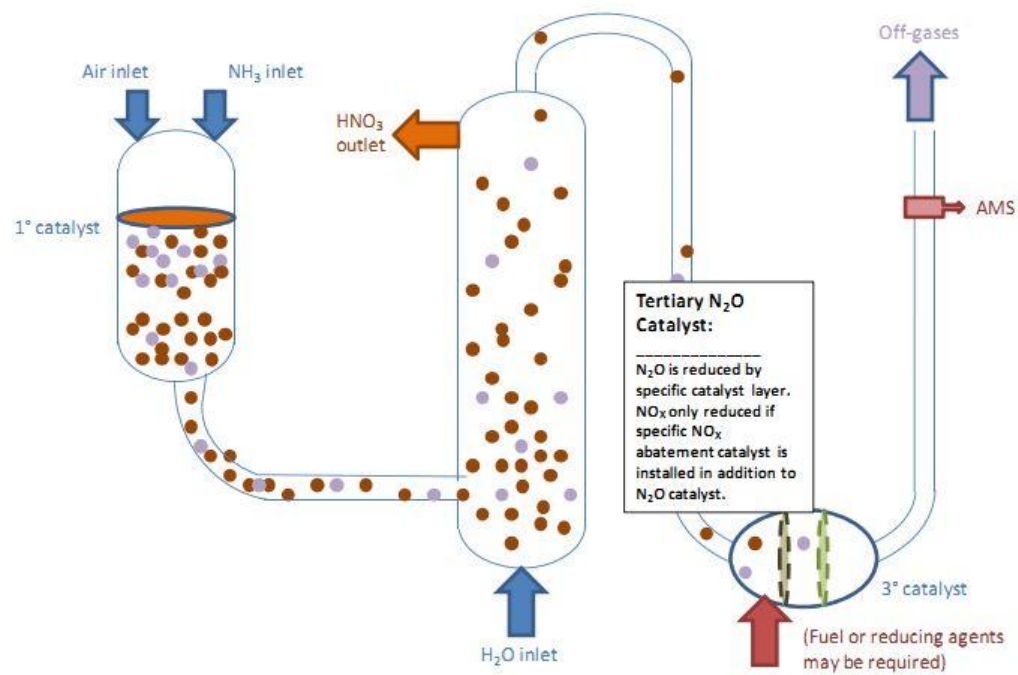


Figure 3: Image flow of tertiary catalyst unit

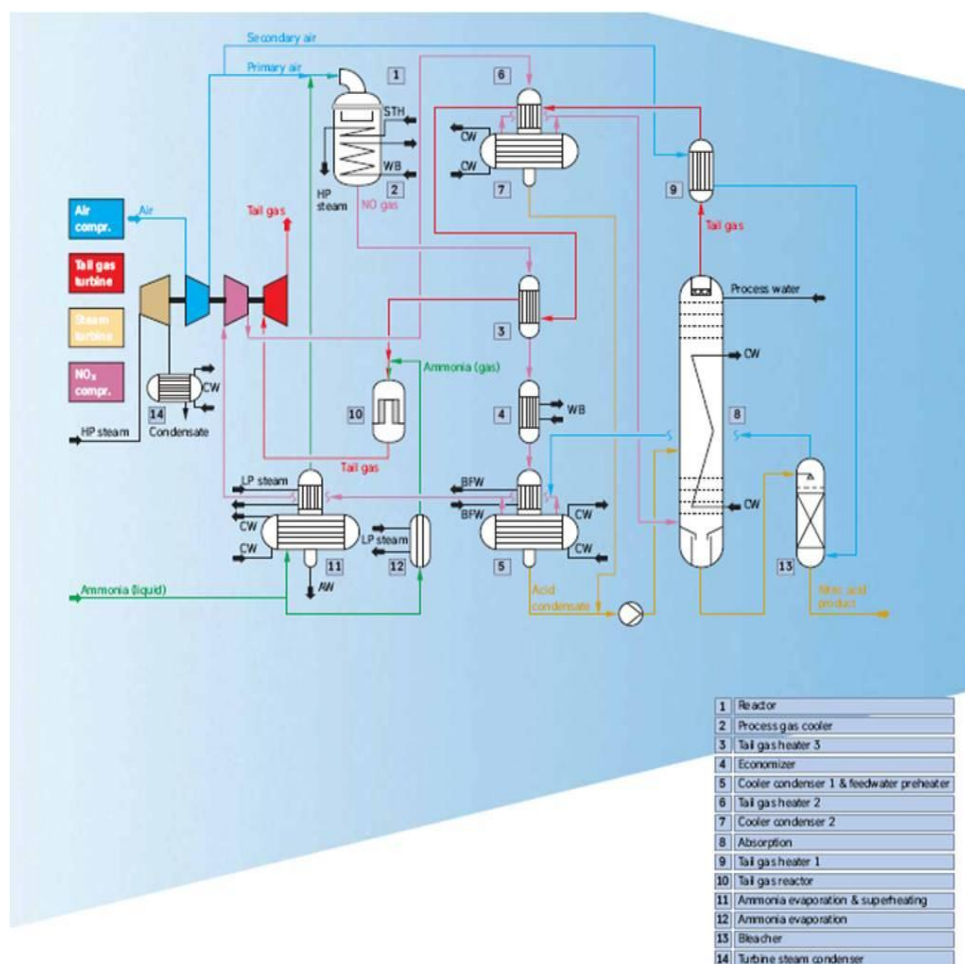


Figure 4: Process flow diagram of the nitric acid plant.

The tertiary abatement system to be implemented and the Fatima Nitric Acid Plant comprise the following technical core details<sup>3</sup>:

| Design parameter              |   |
|-------------------------------|---|
| Plant capacity                | 1,500 t HNO <sub>3</sub> /day <sup>4</sup> plant load |
| Tail gas flow                 | 193,000 Nm <sup>3</sup> /h                            |
| Temperature                   | 440°C   |
| Pressure                      | 9.5 bars  |
| Natural gas consumption       | 0.35 mol CH <sub>4</sub> / 1 mol N <sub>2</sub> O     |
| Operating conditions          |   |
| Min.Reactor inlet temperature | 415 °C  |

<sup>3</sup> The technical details have been derived from Uhde's technical description of its ENVINOx System provided to Fatima Fertilizer Company Limited

<sup>4</sup> For further explanation, please see footnote 1.





|   |                            |
|---|----------------------------|
| Max. Reactor inlet temperature            | 450°C                      |
| Tailgas flow rate to reactor              | 200,000 Nm <sup>3</sup> /h |
| Max. Inlet N <sub>2</sub> O concentration | 2,000 ppm                  |
| <b>Abatement efficiency</b>               |                            |
| Expected abatement efficiency             | 98 %                       |
| Guaranteed abatement efficiency           | 94 %                       |

The project activity is expected to have a minimum life time of ten (10) years and zero (0) months.

#### **A.4.4 Estimated amount of emission reductions over the chosen crediting period:**

The estimated quantity of emission reductions during the crediting period is displayed in the following table.

| <b>Year</b>   | <b>ER<sub>n</sub><br/>(tCO<sub>2</sub>e)</b> |
|---|--|
| 12.2011   | <b>50,537</b>                                |
| 2012  | <b>575,759</b>                               |
| 2013  | <b>545,069</b>                               |
| 2014  | <b>514,379</b>                               |
| 2015  | <b>499,034</b>                               |
| 2016  | <b>468,344</b>                               |
| 2017  | <b>437,654</b>                               |
| 2018  | <b>406,964</b>                               |
| 2019  | <b>391,619</b>                               |
| 2020  | <b>360,929</b>                               |
| 11.2021   | <b>330,851</b>                               |
| <b>Total</b>  | <b>4,581,135</b>                             |
| <b>Crediting years</b>  | <b>10</b>                                    |
| <b>Annual average over the crediting period of estimated reductions (tonnes of CO<sub>2</sub>e)</b> | <b>458,114</b>                               |

Table 1: Overview of estimated emission reductions



For the calculation of the estimated emission reductions it was taken into account:

- The design capacity of 1,500 tHNO<sub>3</sub>/day<sup>5</sup> for 330 operating days<sup>6</sup> per year,
- A default factor (EF<sub>default,y</sub>) (see B.6.2) for calculating baseline emissions (BE<sub>n</sub>). Please note that factual business as usual emissions are assumed to be approximately 7.00 kgN<sub>2</sub>O/tHNO<sub>3</sub>. However, as defined in the methodology, instead of factual business as usual emissions, the default factor is used in order to calculate credible emission reductions.
- A reduction efficiency of 98% and
- 1,213 tCO<sub>2</sub>e/year<sup>7</sup> for the operation of the tertiary system

#### **A.4.5. Public funding of the project activity:**

>>

No development aid funds are involved in the project activity.

### **SECTION B. Application of a baseline and monitoring methodology**

#### **B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:**

>>

Applicable baseline and monitoring methodology:

ACM0019 Version 01.0.0: “N<sub>2</sub>O abatement from nitric acid production”

Methodological tools referred to in ACM0019 as applied in this PDD:

“Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion”

(Version 02)

“Tool to determine the mass flow of a greenhouse gas in a gaseous stream”

(Version 02.0.0)

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<sup>5</sup> For further explanation, please see footnote 1

<sup>6</sup> A design production campaign of 330 days/y is assumed according to statements of the plant’s operator depending on the factual downstream demand for the produced nitric acid. 25 days/y are designated for regular maintenance work, while further 10 days/y of plant downtime are considered for any unforeseeable event. The actual uptime of the plant will be monitored during the production campaigns and can thus significantly deviate from the above assumptions.

<sup>7</sup> The project emissions stemming from the operation of the tertiary abatement system have been calculated ex-ante on basis of the design fossil fuel consumption figures provided by Uhde. Calculations have been undertaken in accordance with the “Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion” (Version 02)”. For a more detailed explanation and figures please see section B.6.3 and Table 5.

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

The chosen baseline methodology ACM0019 is applicable to projects in which tertiary N<sub>2</sub>O abatement technology is installed in the tail gas leaving the absorption column in the nitric acid plant. This corresponds with the proposed project activity.

The applicability criteria of the chosen methodology are met by the project:

- Presently, no N<sub>2</sub>O abatement technology is installed in the plant.
- The plant will be equipped with a complete Automated Monitoring System (AMS). It is used to continuously measure N<sub>2</sub>O concentration and total gas volume flow in the stack during the plant's operation throughout the crediting period.
- The host country does not apply any legal requirements to reduce N<sub>2</sub>O emissions from nitric acid plants (see B.4 for further information).

## B.3. Description of the sources and gases included in the project boundary

The spatial extent of the project boundary encompasses the facility and equipment for the nitric acid production process from the inlet of the ammonia burner to the outlet of the tail gas section.

As the project activity introduces a tertiary N<sub>2</sub>O abatement, then any remaining N<sub>2</sub>O emissions from the project plant and CO<sub>2</sub> emissions arising from the operation of the tertiary abatement system are included as project emissions in the project boundary.

The greenhouse gases included in or excluded from the project boundary are shown in the below table:

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

Table 2: Emission sources included in or excluded from the project boundary (source: ACM0019 version 01.0.0)

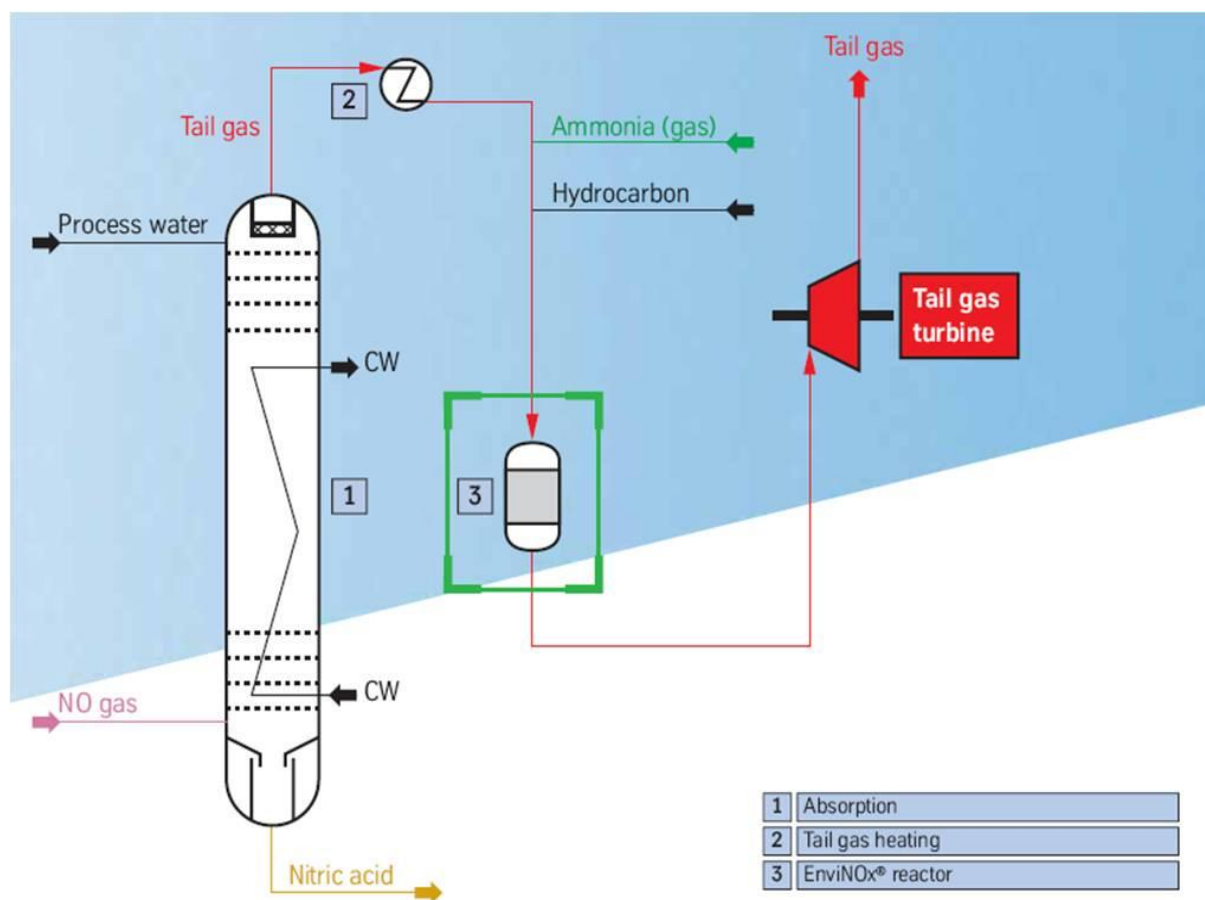


Figure 5: Project boundary for N<sub>2</sub>O abatement project at Fatima

**B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:**

The Environmental Protection Agency Govt. of Pakistan is responsible of any national emission regulations. There are currently no national regulations in Pakistan that limit N<sub>2</sub>O emissions from nitric acid production. In the absence of regulations requiring the abatement of N<sub>2</sub>O emissions, the operator of the nitric acid plant has no economic incentives to take any N<sub>2</sub>O abatement measures because this entails capital and operating costs but no financial benefits. Therefore, the CDM project activity is considered additional and the baseline scenario is that the N<sub>2</sub>O is emitted to the atmosphere with no N<sub>2</sub>O abatement measure being implemented.

**B.5. 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 (assessment and demonstration of additionality): >>**

According to the baseline methodology procedure of the methodology ACM0019 Version 01.0.0, the project activity is considered to be additional in the absence of regulations requiring the abatement of



N<sub>2</sub>O emissions. The operator of the nitric acid plant has no economic incentives to take any N<sub>2</sub>O abatement measure because this entails capital and operation costs but no financial benefits. In the absence of any regulation, the baseline scenario is emitting N<sub>2</sub>O to the atmosphere with no N<sub>2</sub>O abatement measure being implemented.

Since the project start dates back to prior 26/10/2007 evidence has to be provided that the CDM has seriously been considered in the decision to implement the project activity. As well, the project participants must indicate awareness of the CDM prior to the project activity start date. Evidence could –among others- include, inter alia the decision by the Board of Directors of the project participants to undertake a CDM project activity and/or draft PDDs.

Such evidence has been shown and provided to the validating Designated Operational Entity (DOE). Additionally, a list of letters and evidence of E-mail exchange has been provided to the DOE in order to prove for real and continuous action of the project participant since the start of the project activity.

The following list of e-mail exchange provides evidence for such real and continuous action:

| Date       | Events   |
|------------|--|
| 20/09/2006 | Communication with consultant on CDM for Nitric Plant          |
| 12/10/2006 | Email with consultant requesting data of plant                 |
| 11/01/2007 | Email discussion with consultant for meth revision or new meth |
| 28/03/2007 | Email with consultant for Service Contract                     |
| 08/05/2007 | Internal email communication on contract with consultant       |
| 06/08/2007 | Communication with local CDM consultant                        |
| 08/11/2007 | Information to consultant on plant data                        |
| 26/10/2007 | Purchase agreement with Uhde GmbH (project start date)         |
| 26/11/2007 | Email from consultant on meth revision                         |
| 10/12/2007 | Meth revision discussion from consultant                       |
| 13/12/2007 | Data request by consultant for PDD development                 |
| 23/01/2008 | Draft CDM agreement with consultant                            |
| 25/03/2008 | Email from consultant on meth revision submission              |
| 06/05/2008 | 1 <sup>st</sup> MP Revision to UNFCCC                          |
| 25/05/2008 | Email from consultant on meth revision update                  |
| 27/06/2008 | Respond from MP rejected AM REV 0090                           |
| 08/07/2008 | Email discussion for 2nd submission                            |
| 09/09/2008 | Revision document for review                                   |
| 19/09/2008 | 2 <sup>nd</sup> MP Revision to UNFCCC                          |
| 11/11/2008 | Updated from consultant on revision submission                 |
| 31/12/2008 | Email from consultant update                                   |
| 08/05/2009 | Respond from MP rejected AM REV 0115                           |



|            |  |
|------------|--|
| 09/06/2009 | Email from consultant on next step                           |
| 18/06/2009 | Updated from consultant on next step                         |
| 24/07/2009 | Preparation for 3rd submission                               |
| 28/07/2009 | 3 <sup>rd</sup> MP Revision to UNFCCC                        |
| 18/09/2009 | Respond from MP rejected AM REV 0158                         |
| 29/09/2009 | Email with consultant on way forward                         |
| 06/11/2009 | Email to consultant on VERs                                  |
| 01/02/2010 | Email with consultant on new meth values                     |
| 09/04/2010 | Update from consultant on MP concern on adipic acid projects |
| 27/04/2010 | Email from consultant on N.serve submit new meth             |
| 25/06/2010 | Follow email to consultant on progress of new meth           |
| 16/09/2010 | Seeking assistance from UN to appeal for further review      |
| 19/11/2010 | Email with consultant on appeal letter to EB                 |
| 15/03/2011 | Email from Uhde on new meth input request by UNFCCC          |
| 02/05/2011 | Email from N.serve announcing new meth available.            |

Table 3: List of evidence for real and continuous action

**B.6. Emission reductions:****B.6.1. Explanation of methodological choices:**

The ACM0019, Version 01.0.0., was chosen due to the purpose of the methodology:

In the following, the explanation of the calculation of baseline and project emissions, as required under the ACM0019, is presented.

**Baseline emissions:**

*Explanation of calculation method and applicable formula*

$$(1) \quad BE_n = P_{NA,n} * EF_{BL, N_2O,n} * GWP_{N_2O} * 10^{-3}$$

Where:

$BE_n$  = Baseline emissions in monitoring period  $n$  (tCO<sub>2</sub>e)

$P_{NA,n}$  = Nitric acid produced in the monitoring period  $n$  (tHNO<sub>3</sub>)

$EF_{BL, N_2O,n}$  = Baseline N<sub>2</sub>O emission factor for nitric acid production in the monitoring period  $n$  (kgN<sub>2</sub>O/tHNO<sub>3</sub>).



$GWP_{N_2O}$  = Global Warming Potential of  $N_2O$  valid for the commitment period (310  $tCO_2e$ )

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

The baseline  $N_2O$  emission factor in the monitoring period  $n$  ( $EF_{BL,N_2O,n}$ ) shall be determined as a default emission factor  $EF_{default,y}$  given for each calendar year  $y$  for which  $BE_n$  is calculated (see monitoring tables for  $EF_{default,y}$ ), as follows:

$$(2) \quad EF_{BL, N_2O, n} = EF_{default, y}$$

Where:

$EF_{BL, N_2O, n}$  = Baseline  $N_2O$  emission factor for nitric acid production in the monitoring period  $n$  ( $kgN_2O/tHNO_3$ ).

$EF_{default,y}$  = Default  $N_2O$  baseline emissions factor in the calendar year  $y$  of the monitoring period  $n$  ( $kgN_2O/tHNO_3$ ) (see list of  $EF_{default,y}$  values under B.6.2).

**Project Emissions:**

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

Project emissions are calculated using the “Tool to calculate project or leakage  $CO_2$  emissions from fossil fuel combustion” (Version 02) referred to in ACM0019.

Project emissions are calculated as follows:

$$(3) \quad PE_n = PE_{N_2O, n} + PE_{CO_2, tertiary, n}$$

Where:

$PE_n$  = Project emissions in monitoring period  $n$  ( $tCO_2e$ )

$PE_{N_2O, n}$  = Project emissions of  $N_2O$  from the project plant in monitoring period  $n$  ( $tCO_2e$ )

$PE_{CO_2, tertiary, n}$  = Project emissions of  $CO_2$  from the operation of the tertiary  $N_2O$  abatement facility in monitoring period  $n$  ( $tCO_2$ )

The amount of  $N_2O$  emissions from the project activity includes two emission sources:

- The  $N_2O$  contained in the tail gas stream of the plant which is released to the atmosphere and;
- In the case of a tertiary  $N_2O$  abatement, the  $N_2O$  contained in any by-pass streams to the tertiary  $N_2O$  abatement facility.

$$(4) \quad PE_{N_2O, n} = (Q_{N_2O, tail\ gas, n} + Q_{N_2O, by-pass, n}) * GWP_{N_2O}$$



Where:

- $PE_{N_2O,n}$  = Project emissions of  $N_2O$  from the project plant in monitoring period  $n$  ( $tCO_2e$ )
- $Q_{N_2O,tail\ gas,n}$  = Amount of  $N_2O$  released through the tail gas of the project plant to the atmosphere in monitoring period  $n$  ( $tN_2O$ )
- $Q_{N_2O, by-pass;n}$  = Amount of  $N_2O$  released through the by-pass to a tertiary  $N_2O$  abatement system to the atmosphere in monitoring period  $n$  ( $tN_2O$ )<sup>8</sup>
- $GWP_{N_2O}$  = Global warming potential of  $N_2O$  valid for the commitment period ( $310 tCO_2e$ )

*Determination of  $Q_{N_2O,tail\ gas,n}$*

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

- Throughout the crediting periods of the project activity, the  $N_2O$  concentration and volume or mass flow of the tail gas are to be monitored continuously. The monitoring system is to be installed and maintained throughout the crediting period based on the European Norm 14181 (2004), or any more recent update of that standard;
- The monitoring system should provide separate hourly average values for the  $N_2O$  concentration and the volume or mass flow of the tail gas based on 2 seconds (or shorter) interval readings that are recorded and stored electronically. These  $N_2O$  data sets shall be identified by means of a unique time / date key indicating when exactly the values were observed;
- The correction factors derived from the calibration curve of the QAL2 audit for the monitoring components as determined during the QAL2-test in accordance with EN 14181 must be applied to both the  $N_2O$  concentration and the volume or mass flow of the tail gas. This can either be applied automatically to the raw data recorded by the data storage system at the plant or it can be applied to the calculated hourly averages as part of the calculation of project emissions;
- If data for either the  $N_2O$  concentration or the volume or mass flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of  $N_2O$  concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the  $N_2O$  concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of  $N_2O$  calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut-down shall not be used for the determination of the maximum values.

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<sup>8</sup> Please note that for the underlying project activity no by-pass option is foreseen in the current project design. Accordingly, no by-pass emissions will occur throughout the project activity. However, in order to comply with the methodology and for keeping up flexibility in the event of a possible by-pass installation at a later point of time the parameter  $T_{open,n}$  will be monitored throughout the crediting period and has been added to section B.7.1.



According to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) the mass flow of greenhouse gas  $i$  in the gaseous stream in time interval  $t$  ( $F_{i,t}$ ) is calculated based on measurements of

- the total volume flow or mass flow of the gas stream and
- the volumetric fraction of the gas in the gaseous stream and
- the water content and gas composition.

The tool covers possible measurement options, providing six different calculation options to determine the volume or mass flow of a particular greenhouse gas (A-F).

Furthermore, the tool provides two options for the determination of the moisture content of the gaseous stream, while **Option 2** (simplified calculation without measurement of the moisture content) will be applied.

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation.

In order to follow a conservative approach for the determination of the project emissions the gaseous stream is assumed to have a moisture content of “0” and is therefore considered dry.

As the gaseous stream is assumed to be dry **Option B** is chosen for the calculation of the mass flow of greenhouse gas  $i$  ( $F_{i,t}$ ), which is calculated as follows:

$$(5) \quad F_{i,t} = V_{t,db} * V_{i,t,db} * \rho_{i,t}$$

With:

$$(6) \quad \rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t}$$

Where:

|              |  |
|--------------|--|
| $F_{i,t}$    | = mass flow of greenhouse gas $N_2O$ in the gaseous stream in time interval $t$ (kg gas /h)  |
| $V_{t,db}$   | = Volumetric flow of the gaseous stream in time interval $t$ on dry basis ( $m^3$ dry gas/h)   |
| $V_{i,t,db}$ | = Volumetric fraction of greenhouse gas $N_2O$ in the gaseous stream in a time interval $t$ on a dry basis ( $m^3$ gas $N_2O/m^3$ dry gas) |
| $\rho_{i,t}$ | = Density of greenhouse gas $N_2O$ in the gaseous stream in a time interval $t$ (kg gas $N_2O/m^3$ gas $N_2O$ )                            |
| $P_t$        | = Absolute pressure of the gaseous stream in time interval $t$ (Pa)  |
| $MM_i$       | = Molecular mass of greenhouse gas $N_2O$ (kg/kmol)  |
| $R_u$        | = Universal ideal gases constant (Pa.m <sup>3</sup> /kmol.K)   |
| $T_t$        | = Temperature of the gaseous stream in time interval $t$ (K)   |

The volumetric flow of the gaseous stream in time interval  $t$  on a dry basis ( $V_{t,db}$ ) is determined by converting the measured volumetric flow from wet basis to dry basis. The absolute humidity of the gaseous stream ( $m_{H_2O,t,db}$ ) is determined using Option 2 above and accordingly set to be 0. Consequently, equation (8) will result in 0 and thus equation (7) will result in:

$$(7) \quad V_{t,db} = V_{t,wb} / (1 + V_{H_2O,t,db}) = V_{t,wb}$$

Where:

- $V_{t,db}$  = Volumetric flow of the gaseous stream in time interval  $t$  on dry basis ( $m^3$  dry gas/h)  
 $V_{t,wb}$  = Volumetric flow of the gaseous stream in time interval  $t$  on a wet basis ( $m^3$  dry gas/h)  
 $v_{H_2O,t,db}$  = Volumetric fraction of  $H_2O$  in the gaseous stream in time interval  $t$  on a dry basis ( $m^3$   $H_2O/m^3$  dry gas)

The volumetric fraction of  $H_2O$  in time interval  $t$  on a dry basis ( $v_{H_2O,t,db}$ ) is estimated according to equation (8):

$$(8) \quad v_{H_2O,t,db} = \frac{m_{H_2O,t,db} * MM_{t,db}}{MM_{H_2O}}$$

- $v_{H_2O,t,db}$  = Volumetric fraction of  $H_2O$  in the gaseous stream in time interval  $t$  on a dry basis ( $m^3$   $H_2O/m^3$  dry gas)  
 $m_{H_2O,t,db}$  = Absolute humidity in the gaseous stream in time interval  $t$  on a dry basis (kg  $H_2O$ /kg dry gas)  
 $MM_{t,db}$  = Molecular mass of the gaseous stream in time interval  $t$  on a dry basis (kg dry gas/kmol dry gas)  
 $MM_{H_2O}$  = Molecular mass of  $H_2O$  (kg  $H_2O$ /kmol  $H_2O$ )

The hourly values are then aggregated for the duration of the monitoring period  $n$ , as provided in ACM0019:

$$(9) \quad Q_{N_2O,tailgas,n} = \sum_{h=1}^{h=h_n} F_{N_2O,tailgas,h} * 10^{-3}$$

Where:

- $Q_{N_2O,tailgas,n}$  = Amount of  $N_2O$  released through the tail gas of the project plant to the atmosphere in monitoring period  $n$  (t $N_2O$ )  
 $F_{N_2O,tailgas,h}$  = Mass flow of  $N_2O$  in the gaseous stream of the tail gas in the hour  $h$  (kg $N_2O$ /h)  
 $h_n$  = Number of hours in monitoring period  $n$  during which the plant was in operation

During any periods in which a tertiary abatement system is by-passed,  $F_{N_2O,tailgas,h}$  is set to zero in order to avoid double counting of project emissions.

$$(10) \quad Q_{N_2O,by-pass;n} = EF_{BL,N_2O,n} * P_{NA,n} * T_{open,n} * 10^{-3}$$

Where:

- $Q_{N_2O,by-pass;n}$  = Amount of  $N_2O$  released through the by-pass to a tertiary  $N_2O$  abatement system to the atmosphere in monitoring period  $n$  (t $N_2O$ )  
 $EF_{BL,N_2O,n}$  = Default  $N_2O$  baseline emissions factor in the calendar year  $y$  of the monitoring period  $n$  (kg $N_2O$ /t  $HNO_3$ )  
 $P_{NA,n}$  = Nitric acid produced in the monitoring period  $n$  (t $HNO_3$ )

$T_{open,n}$  = Fraction of time in monitoring period  $n$  during which the by-pass valve on the line feeding the tertiary  $N_2O$  abatement facility was open to vent the gas directly to the atmosphere.

*Project emissions from the operation of the tertiary  $N_2O$  abatement facility ( $PE_{CO_2,tertiary,n}$ )*

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

$$(11) \quad PE_{CO_2,tertiary,n} = PE_{FF,n}$$

Where:

$PE_{CO_2,tertiary,n}$  = Project emissions of  $CO_2$  from the operation of the tertiary  $N_2O$  abatement facility in monitoring period  $n$  (t $CO_2$ )

$PE_{FF,n}$  = Project emissions related to fossil fuel input to the destruction facility and/or re-heater in monitoring period  $n$  (t  $CO_2$ )

For the determination of the project emissions related to the operation of the tertiary abatement system in monitoring period  $n$  the project proponents are required to use the latest version of the “Tool to calculate project or leakage  $CO_2$  emissions from fossil fuel combustion.”

The parameter  $PE_{FC,j,y}$  used in the tool corresponds to the parameter  $PE_{FF,n}$  in the applied methodology.

$$(12) \quad PE_{FF,n} = PE_{FC,j,y}$$

$CO_2$  emissions from fossil fuel combustion in process  $j$  are calculated based on the quantity of fuels combusted and the  $CO_2$  emission coefficient of those fuels, as follows:

$$(13) \quad PE_{FC,j,n} = \sum_i FC_{i,j,n} * COEF_{i,n}$$

Where:

$PE_{FC,j,n}$  =  $CO_2$  emissions from fossil fuel combustion in process  $j$  in monitoring period  $n$  (t $CO_2$ /yr)

$FC_{i,j,n}$  = Quantity of fuel type  $i$  combusted in the process  $j$  during the monitoring period  $n$  (mass or volume unit/yr)

$COEF_{i,n}$  =  $CO_2$  emission coefficient of fuel type  $i$  in monitoring period  $n$  (t $CO_2$ /mass or volume unit)

$i$  = Fuel types combusted in process  $j$  during monitoring period  $n$

As data about the chemical composition of the fuel type  $i$  is available  $COEF_{i,n}$  is calculated based on its chemical composition of the fossil fuel type  $i$  using Option A of the “Tool to calculate project or leakage  $CO_2$  emissions from fossil fuel combustion” (Version 02):

$$(14) \quad COEF_{i,n} = w_{C,i,y} * 44/12$$



Where:

$COEF_{i,n}$  =  $CO_2$  emission coefficient of fuel type  $i$  in monitoring period  $n$  ( $tCO_2$ /mass or volume unit)

$w_{C,i,y}$  = Is the weighted average mass fraction of carbon in fuel type  $i$  in year  $y$  (tC/mass unit of the fuel)

### Leakage emissions:

Any leakage emissions sources are deemed to be negligible.

### Emission reductions:

Emission reductions are calculated as follows:

$$(15) \quad ER_n = BE_n - PE_n$$

Where:

$ER_n$  = Emission reductions in monitoring period  $n$  ( $tCO_2e$ )

$BE_n$  = Baseline emissions in monitoring period  $n$  ( $tCO_2e$ )

$PE_n$  = Project emissions in monitoring period  $n$  ( $tCO_2e$ )

#### B.6.2. Data and parameters that are available at validation:

| Data / Parameter:    | $EF_{default,y}$  |      |                                      |      |      |      |      |      |      |      |      |      |      |
|----------------------|---|------|--------------------------------------|------|------|------|------|------|------|------|------|------|------|
| Data unit:           | $kgN_2O/tHNO_3$   |      |                                      |      |      |      |      |      |      |      |      |      |      |
| Description:         | Default $N_2O$ baseline emissions factor in the calendar year $y$ of the monitoring period $n$  |      |                                      |      |      |      |      |      |      |      |      |      |      |
| Source of data used: | According to ACM0019 Version 01.0.0, the default $N_2O$ baseline emission factor varies every year until it will remain constant after 2020, as provided in the following table:  |      |                                      |      |      |      |      |      |      |      |      |      |      |
| Value applied:       | <table> <tr> <th>Year</th><th>Emissions factor (<math>kgN_2O/tHNO_3</math>)</th></tr> <tr> <td>2011</td><td>4.10</td></tr> <tr> <td>2012</td><td>3.90</td></tr> <tr> <td>2013</td><td>3.70</td></tr> <tr> <td>2014</td><td>3.50</td></tr> <tr> <td>2015</td><td>3.40</td></tr> </table> | Year | Emissions factor ( $kgN_2O/tHNO_3$ ) | 2011 | 4.10 | 2012 | 3.90 | 2013 | 3.70 | 2014 | 3.50 | 2015 | 3.40 |
| Year                 | Emissions factor ( $kgN_2O/tHNO_3$ )  |      |                                      |      |      |      |      |      |      |      |      |      |      |
| 2011                 | 4.10  |      |                                      |      |      |      |      |      |      |      |      |      |      |
| 2012                 | 3.90  |      |                                      |      |      |      |      |      |      |      |      |      |      |
| 2013                 | 3.70  |      |                                      |      |      |      |      |      |      |      |      |      |      |
| 2014                 | 3.50  |      |                                      |      |      |      |      |      |      |      |      |      |      |
| 2015                 | 3.40  |      |                                      |      |      |      |      |      |      |      |      |      |      |



|  |  |      |  |
|--|--|------|--|
|  | 2016   | 3.20 |  |
|  | 2017   | 3.00 |  |
|  | 2018   | 2.80 |  |
|  | 2019   | 2.70 |  |
|  | 2020   | 2.50 |  |
|  | 2021   | 2.50 |  |
|  | Year n   | 2.50 |  |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | No measurement procedures, specified in the methodology.   |      |  |
| Any comment:   | The decrease in the value for the baseline emission factor over time is to reflect the technological development. Please note that the factual business as usual emissions are estimated to be 7.00 kgN <sub>2</sub> O/tHNO <sub>3</sub> . |      |  |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | <b><math>GWP_{N_2O}</math></b>                |
| Data unit:   | tCO <sub>2</sub> e/tN <sub>2</sub> O          |
| Description:   | Global warming potential of the nitrous oxide |
| Source of data used:   | Relevant decisions by the CMP                 |
| Value applied:   | 310   |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | Specified in the methodology.                 |
| Any comment:   |   |

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

|                          |  |
|--------------------------|--|
| <b>Data / Parameter:</b> | <b><math>R_u</math></b>  |
| Data unit:               | Pa.m <sup>3</sup> /kmol.K  |
| Description:             | Universal ideal gases constant   |
| Source of data used:     | “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) |



|  |       |
|--|-------|
| Value applied:   | 8,314 |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | N/A   |
| Any comment:   | N/A   |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>MM<sub>i</sub></b>  |
| Data unit:   | kg/kmol  |
| Description:   | Molecular mass of greenhouse gas <i>i</i> ( <i>N<sub>2</sub>O</i> )                        |
| Source of data used:   | “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) |
| Value applied:   | 44.02  |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | N/A  |
| Any comment:   | N/A  |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>P<sub>n</sub></b>   |
| Data unit:   | Pa   |
| Description:   | Total pressure at normal conditions  |
| Source of data used:   | “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) |
| Value applied:   | 101,325  |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | N/A  |
| Any comment:   | N/A  |

|                          |                      |
|--------------------------|----------------------|
| <b>Data / Parameter:</b> | <b>T<sub>n</sub></b> |
| Data unit:               | K                    |



|  |  |
|--|--|
| Description:   | Temperature at normal conditions   |
| Source of data used:   | “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0) |
| Value applied:   | 273.15   |
| Justification of the choice of data or description of measurement methods and procedures actually applied: | N/A  |
| Any comment:   | N/A  |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | <b>T<sub>open,n</sub></b>   |
| Data unit:   | %   |
| Description:   | Fraction of time in monitoring period <i>n</i> during which the by-pass valve on the line feeding the tertiary N <sub>2</sub> O abatement facility was open to vent the gas directly to the atmosphere. |
| Source of data to be used:                                       | N/A   |
| Value of data applied  | 0   |
| Description of measurement methods and procedures to be applied: | N/A   |
| QA/QC procedures to be applied:                                  | N/A   |
| Any comment:   | No by-pass is foreseen in the project design and therefore no by-pass valve will be installed from the beginning of the project activity. If necessary, plant will shut down.                           |

### B.6.3 Ex-ante calculation of emission reductions:

For the calculation of the estimated emission reductions it was taken into account:

- The design capacity of 1,500 tHNO<sub>3</sub>/day<sup>9</sup> for 330 operating days per year,
- A default factor (EF<sub>default,y</sub>) (see B.6.2) for calculating baseline emissions (BE<sub>n</sub>), (Please note that factual business as usual emissions are assumed to be approximately 7.00 kgN<sub>2</sub>O/tHNO<sub>3</sub>. However, as defined in the methodology, instead of factual business as usual emissions, the default factor is used in order to calculate credible emission reductions)

<sup>9</sup> For further explanation, please see footnote 1.

- An expected reduction efficiency of 98%<sup>10</sup> and
- 1,213 tCO<sub>2</sub>e (ex-ante calculation) for the operation of the tertiary system.

#### Baseline emissions:

$$(1) \quad BE_n = P_{NA,n} * EF_{BL, N_2O,n} * GWP_{N_2O} * 10^{-3}$$

Where:

$BE_n$  = Baseline emissions in monitoring period  $n$  (tCO<sub>2</sub>e)

$P_{NA,n}$  = Nitric acid produced in the monitoring period  $n$  (tHNO<sub>3</sub>)

$EF_{BL, N_2O,n}$  = Default N<sub>2</sub>O baseline emissions factor in the calendar year  $y$  of the monitoring period  $n$  (kgN<sub>2</sub>O/tHNO<sub>3</sub>). The baseline N<sub>2</sub>O emission factor in the monitoring period  $n$  ( $EF_{BL, N_2O,n}$ ) shall be determined as a default emission factor  $EF_{default,y}$  given for each calendar year  $y$  for which  $BE_n$  is calculated (see monitoring tables for  $EF_{default,y}$ )

$GWP_{N_2O}$  = Global Warming Potential of N<sub>2</sub>O valid for the commitment period of 310 tCO<sub>2</sub>e

The following table displays the estimated baseline emissions for the project activity over the crediting period of 10 years starting in 2011:

| Year    | $EF_{default,y}$<br>(kgN <sub>2</sub> O/<br>tHNO <sub>3</sub> ) | $P_{NA,n}$<br>(tHNO <sub>3</sub> ) | GWP<br>(N <sub>2</sub> O) | $BE_n$<br>(tCO <sub>2</sub> e) |
|---------|---|------------------------------------|---------------------------|--------------------------------|
| 12.2011 | 4.1   | 41,250                             | 310                       | <b>52,429</b>                  |
| 2012    | 3.9   | 495,000                            | 310                       | <b>598,455</b>                 |
| 2013    | 3.7   | 495,000                            | 310                       | <b>567,765</b>                 |
| 2014    | 3.5   | 495,000                            | 310                       | <b>537,075</b>                 |
| 2015    | 3.4   | 495,000                            | 310                       | <b>521,730</b>                 |
| 2016    | 3.2   | 495,000                            | 310                       | <b>491,040</b>                 |
| 2017    | 3.0   | 495,000                            | 310                       | <b>460,350</b>                 |
| 2018    | 2.8   | 495,000                            | 310                       | <b>429,660</b>                 |
| 2019    | 2.7   | 495,000                            | 310                       | <b>414,315</b>                 |
| 2020    | 2.5   | 495,000                            | 310                       | <b>383,625</b>                 |
| 11.2021 | 2.5   | 453,750                            | 310                       | <b>351,656</b>                 |
| Total   |   | 4,950,000                          |                           | <b>4,808,100</b>               |

Table 4: Overview of estimated baseline emissions during the project activity over the crediting period of 10 years starting in 01/12/2011.<sup>11</sup>

<sup>10</sup> The reduction efficiency of 98% is to be considered as the expected N<sub>2</sub>O-abatement efficiency of the tertiary catalyst as provided in the technical description of the abatement system. It differs from the guaranteed value, which is 94%. The technical description was provided to the DOE during on-site visit.



**Project Emissions:**

$$(2) \quad PE_n = PE_{N_2O,n} + PE_{CO_2,tertiary,n}$$

$$(3) \quad PE_{N_2O,n} = (Q_{tail\ gas,n} + Q_{N_2O,by-pass,n}) * GWP_{N_2O}$$

Where:

$PE_n$  = Project emissions in monitoring period  $n$  (tCO<sub>2</sub>e)

$PE_{N_2O,n}$  = Project emissions of N<sub>2</sub>O from the project plant in monitoring period  $n$  (tCO<sub>2</sub>e)

$PE_{CO_2,tertiary,n}$  = Project emissions of CO<sub>2</sub> from the operation of the tertiary N<sub>2</sub>O abatement facility in monitoring period  $n$  (tCO<sub>2</sub>)

$Q_{tail\ gas,n}$  = Amount of N<sub>2</sub>O released through the tail gas of the project plant to the atmosphere in monitoring period  $n$  (tN<sub>2</sub>O)

$Q_{N_2O,by-pass,n}$  = Amount of N<sub>2</sub>O released through the by-pass to a tertiary N<sub>2</sub>O abatement system to the atmosphere in monitoring period  $n$  (tN<sub>2</sub>O)

$GWP_{N_2O}$  = Global warming potential of N<sub>2</sub>O valid for the commitment period

CO<sub>2</sub>- project emissions from the operation of the tertiary N<sub>2</sub>O abatement facility will be assessed by using the “Tool to calculate project or leakage CO<sub>2</sub> emissions from fossil fuel combustion” (Version 02). However, since no abatement technology is installed yet, the parameter will be correctly determined during the verifications.

For the purpose of estimating the complete project emissions ( $PE_n$ ), an ex-ante calculation was undertaken on the basis of design consumption figures provided by Uhde. The catalyst system will be fed with natural gas providing CH<sub>4</sub>, which will be utilized as a reduction agent for the decomposition of N<sub>2</sub>O in a quantity of 0.35 mol CH<sub>4</sub>/1 mol N<sub>2</sub>O. The plant is connected to the natural gas and therefore exclusively utilizes natural gas as hydrocarbon for the decomposition of N<sub>2</sub>O. Formula (13) is applied for the determination of the parameter  $PE_{FC,i,j}$ , which is equal to parameter  $PE_{CO_2,tertiary,n}$  of ACM0019 resulting in estimated emissions of 1,213 tCO<sub>2</sub>e per year for the operation of the tertiary system.

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<sup>11</sup>All calculations are based on the design parameters for the plant as provided by Uhde:  $P_{NA,n} = 1,500$  t HNO<sub>3</sub> per day multiplied by 330 days of operation.



| Year         | PE <sub>N<sub>2</sub>O,n</sub><br>(tCO <sub>2</sub> e) | PE <sub>CO<sub>2</sub>,tertiary,n</sub><br>(tCO <sub>2</sub> e) | PE <sub>n</sub><br>(tCO <sub>2</sub> e) |
|--------------|--|---|---|
| 12.2011      | 1,790  | 101   | <b>1,891</b>                            |
| 2012         | 21,483   | 1,213   | <b>22,696</b>                           |
| 2013         | 21,483   | 1,213   | <b>22,696</b>                           |
| 2014         | 21,483   | 1,213   | <b>22,696</b>                           |
| 2015         | 21,483   | 1,213   | <b>22,696</b>                           |
| 2016         | 21,483   | 1,213   | <b>22,696</b>                           |
| 2017         | 21,483   | 1,213   | <b>22,696</b>                           |
| 2018         | 21,483   | 1,213   | <b>22,696</b>                           |
| 2019         | 21,483   | 1,213   | <b>22,696</b>                           |
| 2020         | 21,483   | 1,213   | <b>22,696</b>                           |
| 11.2021      | 19,693   | 1,112   | <b>20,805</b>                           |
| <b>Total</b> | <b>214,830</b>   | <b>12,135</b>   | <b>226,965</b>                          |

Table 5: Overview of estimated project emissions during the project activity over the crediting period of 10 years starting in 01/12/2011.

#### Emission reductions

$$(4) \quad ER_n = BE_n - PE_n$$

Where:

ER<sub>n</sub> = Emission reductions in monitoring period *n* (t CO<sub>2</sub>e)

BE<sub>n</sub> = Baseline emissions in monitoring period *n* (t CO<sub>2</sub>e)

PE<sub>n</sub> = Project emissions in monitoring period *n* (t CO<sub>2</sub>e)

| Year         | BE <sub>n</sub><br>(tCO <sub>2</sub> e) | PE <sub>n</sub><br>(tCO <sub>2</sub> e) | ER <sub>n</sub><br>(tCO <sub>2</sub> e) |
|--------------|---|---|---|
| 12.2011      | 52,429                                  | 1,891                                   | <b>50,537</b>                           |
| 2012         | 598,455                                 | 22,696                                  | <b>575,759</b>                          |
| 2013         | 567,765                                 | 22,696                                  | <b>545,069</b>                          |
| 2014         | 537,075                                 | 22,696                                  | <b>514,379</b>                          |
| 2015         | 521,730                                 | 22,696                                  | <b>499,034</b>                          |
| 2016         | 491,040                                 | 22,696                                  | <b>468,344</b>                          |
| 2017         | 460,350                                 | 22,696                                  | <b>437,654</b>                          |
| 2018         | 429,660                                 | 22,696                                  | <b>406,964</b>                          |
| 2019         | 414,315                                 | 22,696                                  | <b>391,619</b>                          |
| 2020         | 383,625                                 | 22,696                                  | <b>360,929</b>                          |
| 11.2021      | 351,656                                 | 20,805                                  | <b>330,851</b>                          |
| <b>Total</b> | <b>4,808,100</b>                        | <b>226,965</b>                          | <b>4,581,135</b>                        |

Table 6: Overview of estimated emission reductions during the project activity over the crediting period of 10 years starting in 01/12/2011.

**B.6.4 Summary of the ex-ante estimation of emission reductions:**

| Year                                       | Estimation of project activity emissions (tonnes of CO <sub>2</sub> e) | Estimation of baseline emissions (tonnes of CO <sub>2</sub> e) | Estimation of leakage (tonnes of CO <sub>2</sub> e) | Estimation of overall emission reductions (tonnes of CO <sub>2</sub> e) |
|--|--|--|---|---|
| 12.2011                                    | 1,891  | 52,429   | 0   | 50,537  |
| 2012                                       | 22,696   | 598,455  | 0   | 575,759   |
| 2013                                       | 22,696   | 567,765  | 0   | 545,069   |
| 2014                                       | 22,696   | 537,075  | 0   | 514,379   |
| 2015                                       | 22,696   | 521,730  | 0   | 499,034   |
| 2016                                       | 22,696   | 491,040  | 0   | 468,344   |
| 2017                                       | 22,696   | 460,350  | 0   | 437,654   |
| 2018                                       | 22,696   | 429,660  | 0   | 406,964   |
| 2019                                       | 22,696   | 414,315  | 0   | 391,619   |
| 2020                                       | 22,696   | 383,625  | 0   | 360,929   |
| 11.2021                                    | 20,805   | 351,656  | 0   | 330,851   |
| <b>Total</b> (tonnes of CO <sub>2</sub> e) | 226,965  | 4,808,100  | 0   | 4,581,135   |

Table 7: Summary of ex-ante estimation of emission reductions

**B.7 Application of the monitoring methodology and description of the monitoring plan:**

>> The monitoring points for key parameters are shown below:

**B.7.1 Data and parameters monitored:**

|                            |   |
|----------------------------|---|
| <b>Data / Parameter:</b>   | <b>P<sub>NA,n</sub></b>   |
| Data unit:                 | tHNO <sub>3</sub>   |
| Description:               | Nitric acid produced in the monitoring period <i>n</i>  |
| Source of data to be used: | Volume of HNO <sub>3</sub> is continuously measured by a flow meter.<br>Density & acid concentration are determined by laboratory analysis. |
| Value of data applied      | Not available for validation. Will be monitored ex-post.  |



|  |  |
|--|--|
| Description of measurement methods and procedures to be applied: | <p>Volume of <math>\text{HNO}_3</math> is continuously measured by a magnetic flow meter manufactured by Krohne Germany.</p> <p>Density &amp; acid concentration are determined by laboratory analysis.</p> <p>100 % <math>\text{HNO}_3</math> is calculated by the available data, which are cross-checked against tank level measurements, when downstream plants (CAN and NP) are shutdown. This will be continued until a new Coriolis flow meter will be installed to ease the cross-checking procedure in the future. Once in place, it will be used to counter check the production figures of the magnetic flow meter.</p> |
| QA/QC procedures to be applied:                                  | <p>Maintenance and calibration of the flow meter and density meter will be applied under the internal QA/QC procedures to be implemented for this project activity.</p> <p>Fatima prepares to acquire ISO9001 accreditation however at the time of writing this PDD the timeframe is not yet confirmed. All plant equipment and piping are designed as per ASME standards and their maintenance/QAQC is based on relevant API standards, vendor recommendations and prevailing practices in fertilizer industry.</p>   |
| Any comment:   |  |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | $F_{\text{N}_2\text{O}, \text{tailgas}, h}$  |
| Data unit:   | kg $\text{N}_2\text{O}$ /h   |
| Description:   | Mass flow of $\text{N}_2\text{O}$ in the gaseous stream of the tail gas in the hour h  |
| Source of data to be used:                                       | <p><math>\text{N}_2\text{O}</math> concentration: <math>\text{N}_2\text{O}</math> analyzer</p> <p>Stack gas volume flow: flow meter</p>  |
| Value of data applied  | Not available for validation. Will be monitored ex-post.   |
| Description of measurement methods and procedures to be applied: | <ul style="list-style-type: none"> <li>Throughout the crediting periods of the project activity, the <math>\text{N}_2\text{O}</math> concentration and volume or mass flow of the tail gas are to be monitored continuously. The monitoring system is to be installed and maintained throughout the crediting period based on the European Norm 14181 (2004), or any more recent update of that standard;</li> <li>The monitoring system should provide separate hourly average values for the <math>\text{N}_2\text{O}</math> concentration and the volume or mass flow of the tail gas based on 2 seconds (or shorter) interval readings that are recorded and stored electronically. These <math>\text{N}_2\text{O}</math> data sets shall be identified by means of a unique time / date key indicating when exactly the values were observed;</li> <li>The correction factors derived from the calibration curve of the QAL2 audit for the monitoring components as determined during the QAL2-test in accordance with EN 14181 must be applied to both the <math>\text{N}_2\text{O}</math> concentration and the volume or mass flow of the tail gas. This can either be applied automatically to the raw data recorded by the data storage system at the plant or it can be applied to the calculated hourly averages as part of the calculation of project emissions.</li> </ul> <p>If data for either the <math>\text{N}_2\text{O}</math> concentration or the volume or mass flow of the</p> |



|                                 |   |
|---------------------------------|---|
|                                 | <p>tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N<sub>2</sub>O concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the N<sub>2</sub>O concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of N<sub>2</sub>O calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut-down shall not be used for the determination of the maximum values.</p> <p>The hourly values are then aggregated as follows:</p> $Q_{N2O,tailgas,n} = \sum_{h=1}^{h=h_n} F_{N2O,tailgash} * 10^{-3}$ |
| QA/QC procedures to be applied: | <ul style="list-style-type: none"> <li>According to EN 14181, the flow meter and the analyzer will be tested and calibrated by an external laboratory with EN ISO IEC 17025 Accreditation. The QAL2 test is conducted once every 3 years; the AST test is conducted once per year. Every 3 years the AST test is part of the QAL2 test<sup>12</sup>.</li> </ul>   |
| Any comment:                    |   |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | <b>h<sub>n</sub></b>  |
| Data unit:   | Hours   |
| Description:   | Number of hours in monitoring period <i>n</i> during which the plant was in operation |
| Source of data to be used:                                       | Fatima production log and continuous monitoring according to operational parameters   |
| Value of data applied  | Not available for validation. Will be monitored ex-post.                              |
| Description of measurement methods and procedures to be applied: | The total operating hours are logged continuously in the production log.              |
| QA/QC procedures to be applied:                                  |   |

<sup>12</sup> Due to the fact that conducting the QAL2 and AST both require the plant being in operation some flexibility in regard to actual date of conduction is required. Events such as plant shut-down along with the aspects of availability and required planning time (the test is to be carried out by an independent 3<sup>rd</sup> party holding respective accreditation, which usually comes from overseas) as well as customs check of the equipment, etc. can easily delay execution of the test. This means that although once every year either QAL2 or AST shall be conducted the actual time period between 2 consecutive performances is not mandatorily bound to strictly one year (365 days) but allows for some tolerance. Nevertheless, under consideration of operating conditions and practical reasons it is generally aimed on performing the tests one to another as close to one year as possible.



|              |   |
|--------------|---|
| Any comment: | In order to calculate the expected emission reductions in section B.6 the expected operating hours of the plant within one year were applied. |
|--------------|---|

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|--|--|
| <b>Data / Parameter:</b>   | $T_{open,n}$   |
| Data unit:   | %  |
| Description:   | Fraction of time in monitoring period $n$ during which the by-pass valve on the line feeding the tertiary $N_2O$ abatement facility was open to vent the gas directly to the atmosphere. |
| Source of data to be used:                                       | measured   |
| Value of data applied  | Not available for validation. Will be monitored ex-post.   |
| Description of measurement methods and procedures to be applied: | N/A  |
| QA/QC procedures to be applied:                                  | N/A  |
| Any comment:   | No by-pass is foreseen in the project design and therefore no by-pass valve will be installed from the beginning of the project activity. If necessary, plant will shut down.            |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | $PE_{FF,n}$ (corresponding to $PE_{CO_2,tertiary,n}$ )   |
| Data unit:   | tCO <sub>2</sub> e   |
| Description:   | Project emissions related to fossil fuel input to the destruction facility and/or re-heater in monitoring period $n$ (tCO <sub>2</sub> )   |
| Source of data to be used:                                       | The emissions related to the operation of the $N_2O$ destruction facility include only on-site emissions due to fossil fuel use as input to the $N_2O$ destruction facility. Natural gas consumption will be measured by a mass-flow meter |
| Value of data applied  | Parameter $PE_{CO_2,tertiary,n}$<br>(see further above)  |
| Description of measurement methods and procedures to be applied: | calculated Based on measurement of natural gas consumption and NCV   |
| QA/QC procedures to be applied:                                  | Maintenance and calibration of the mass flow meter is applied under the internal QA/QC procedures.   |
| Any comment:   | -  |

|                          |                          |
|--------------------------|--------------------------|
| <b>Data / Parameter:</b> | $w_{C,i,y}$              |
| Data unit:               | tC/mass unit of the fuel |



|  |  |   |
|--|--|---|
| Description:   | Weighted average mass fraction of carbon in fuel type <i>i</i> in year <i>y</i>  |   |
| Source of data to be used:   | The following data sources may be used if the relevant conditions apply:   |   |
|  | <b>Data source</b>   | <b>Conditions for using the data source</b> |
|  | a) Values provided by the fuel supplier in invoices  | This is the preferred source                |
|  | b) Measurements by the project participants  | If a) is not available                      |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | N/A  |   |
| Measurement procedure (if any)   | Measurements should be undertaken in line with national or international fuel standards  |   |
| Monitoring frequency   | The mass fraction of carbon should be obtained for each fuel delivery, from which weighted average annual values should be calculated  |   |
| QA/QC procedures to be applied:  | Verify if the values under a) and b) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in b) should have ISO17025 accreditation or justify that they can comply with similar quality standards. |   |
| Any comment:   | Applicable where Option A is used  |   |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | <b>FC<sub>i,j,y</sub></b>   |
| Data unit:   | Mass unit per year (ton/yr)   |
| Description:   | Quantity of fuel type <i>i</i> combusted in process <i>j</i> during the year <i>y</i>   |
| Source of data to be used:                                       | Onsite measurements   |
| Value of data applied  | N/A   |
| Description of measurement methods and procedures to be applied: | <ul style="list-style-type: none"> <li>• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: The ruler gauge must be part of the daily tank and calibrated at least once a year and have a book of control for recording the measurements (on a daily basis or per shift);</li> <li>• Accessories such as transducers, sonar and piezoelectric devices are accepted if they are properly calibrated with the ruler gauge and</li> </ul> |



|                                 |   |
|---------------------------------|---|
|                                 | <p>receiving a reasonable maintenance;</p> <ul style="list-style-type: none"> <li>In case of daily tanks with pre-heaters for heavy oil, the calibration will be made with the system at typical operational conditions</li> </ul>  |
| Monitoring frequency:           | continuously  |
| QA/QC procedures to be applied: | <p>The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes.</p> <p>Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.</p> |
| Any comment:                    | -   |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | $V_{t,wb}$  |
| Data unit:   | $m^3$ wet gas/h   |
| Description:   | Volumetric flow of the gaseous stream in time interval $t$ on a wet basis   |
| Source of data:  | Tail gas volume flow meter  |
| Value to be applied  | N/A   |
| Description of measurement methods and procedures to be applied: | Volumetric flow measurements should always refer to the actual pressure and temperature.  |
| Monitoring frequency   | continuously  |
| QA/QC procedures to be applied:                                  | Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. For details on calibration and calibration frequency, please refer to section B.7.2. |
| Any comment:   | -   |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | $V_{i,t,db}$  |
| Data unit:   | $m^3$ gas $i$ / $m^3$ dry gas   |
| Description:   | Volumetric fraction of greenhouse gas $i$ in a time interval $t$ on a dry basis     |
| Source of data to be used:                                       | $N_2O$ gas analyzer   |
| Value to be applied  |   |
| Description of measurement methods and procedures to be applied: | Continuous gas analyzer operating in dry-basis.                                     |
| Monitoring frequency   | continuously  |
| QA/QC procedures to  | Calibration should include zero verification with an inert gas (e.g. $N_2$ ) and at |





|              |   |
|--------------|---|
| be applied:  | least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period. |
| Any comment: | Maybe converted from ppm if necessary   |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | $T_t$  |
| Data unit:   | °C   |
| Description:   | Temperature in the gaseous stream in time interval $t$   |
| Source of data to be used:                                       | Tail gas temperature measurement   |
| Description of measurement methods and procedures to be applied: | Instruments with recordable electronic signal (analogical or digital) are required.  |
| Monitoring frequency   | continuously   |
| QA/QC procedures to be applied:                                  | Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications  |
| Any comment:   | Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60°C is adopted, this parameter must be monitored continuously to assure the applicability condition is met |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | $P_t$  |
| Data unit:   | Pa   |
| Description:   | Pressure of the gaseous stream in time interval $t$  |
| Source of data to be used:                                       | Tail gas pressure measurement  |
| Description of measurement methods and procedures to be applied: | Instruments with recordable electronic signal (analogical or digital) are required   |
| Monitoring frequency   | continuously   |
| QA/QC procedures to be applied:                                  | Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly. |
| Any comment:   | Provided all parameters are converted to normal conditions during the  |



|  |  |
|--|--|
|  | monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency). However, if the applicability condition related to the gaseous stream flow temperature being below 60°C is adopted, this parameter must be monitored continuously to assure the applicability condition is met |
|--|--|

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | ER <sub>n</sub>  |
| Data unit:   | tCO <sub>2</sub> e   |
| Description:   | Emission reductions in monitoring period n   |
| Source of data to be used:                                       | Calculated   |
| Value of data applied  | Not available for validation. Will be third party audited during the first verification. |
| Description of measurement methods and procedures to be applied: | Not applicable. Is calculated using the following formula:<br>$ER_n = BE_n - PE_n$       |
| QA/QC procedures to be applied:                                  | N/A  |
| Any comment:   | -  |

**B.7.2 Description of the monitoring plan:****Organization Structure with Management & Operation Process**

As an operator of nitric acid plants since many years, the plant's staff in general and its instrument department in particular is accustomed to operating technical equipment adhering to high quality standards.

Fatima Fertilizer will train the staff selected for the operation of the relevant monitoring systems and ensures that the operational standards required for the appropriate handling of the equipment will be maintained throughout the crediting period. Measuring instruments will be calibrated by the instrumentation engineer in accordance with the requirements of the instrument suppliers. The operations and equipment engineers of the nitric acid plant are responsible for the daily operation and maintenance of the systems.

The monitoring of the parameters for the determination of the mass flow of the N<sub>2</sub>O will be the responsibility of the monitoring department. All relevant data will be recorded automatically and stored on electronic media.

**Quality Assurance**

ACM0019 requires the use of the European Norm EN 14181 (2004) "Stationary source emissions - Quality assurance of automated measuring systems" as a guidance for installing and operating the Automated Monitoring System (AMS) for the monitoring of N<sub>2</sub>O emissions in the nitric acid plant.

The plant will be equipped with such Automated Monitoring Systems (AMS) to monitor the mass emissions of N<sub>2</sub>O in the tail gas of the nitric acid plant.

In the following, it is described how the procedures given in EN 14181 for QAL1-3 will be applied at the plant.

*QAL1*

In accordance with EN 14181, the monitoring system for N<sub>2</sub>O concentration measurements shall have been proven suitable for its measuring task (parameter and composition of the flue gas) by use of the QAL1 procedure as specified by EN ISO 15267 or equivalent standards. This standard's objective is to prove that the total uncertainty of the results obtained from the AMS meets the specification for uncertainty stated in the applicable regulations. Such suitability testing has to be carried out under specific conditions by an independent third party on a specific testing site.

*QAL2*

QAL2 is a procedure for the determination of the calibration function and its variability. According to EN 14181, the QAL2 test including the SRM need to be conducted by an independent "testing house"



or laboratory which has to be accredited to EN ISO/IEC 17025. The QAL2 tests are performed on suitable AMS that have been correctly installed and commissioned on-site (as opposed to QAL1 which is conducted off-site).

A calibration function is established from the results of a number of parallel measurements performed with a Standard Reference Method (SRM). The variability of the measured values obtained with the AMS is then evaluated by the independent qualified “testing house”.

QAL2 tests are to be performed at least every 5 years<sup>13</sup> according to EN 14181.

#### *AST*

In addition, Annual Surveillance Tests (AST) should be conducted in accordance with EN 14181; these are a series of measurements with independent measurement equipment in parallel to the existing AMS. The AST tests are performed annually<sup>14</sup>. If a full QAL2 test is performed (at least every 5 years), an additional AST test is not necessary in that same year.

#### *QAL3*

QAL3 describes the ongoing quality assurance and maintenance procedures and documentation for the AMS conducted by the plant operator. With this documentation it can be demonstrated that the AMS is in control during its operation so that it continues to function within the required specifications.

In essence, staff performs QAL3 procedures through the established calibration procedures.

### **Accuracy and calibration of instruments**

All meters will be purchased and maintained to ensure a high level of accuracy. The exact specifications of each meter will be determined during the detailed design of the project. Thereafter the meter accuracies will be included in this procedure and steps taken to maintain those levels of accuracy.

All key meters will be subject to a quality control regime that will include regular maintenance and calibration. A record will be maintained showing the location and unique identification number of each meter, the calibration status of that meter (when last calibrated, when next due for calibration)

---

<sup>13</sup> Due to the fact that conducting the QAL2 and AST both require the plant being in operation some flexibility in regard to actual date of conduction is required. Events such as plant shut-down along with the aspects of availability and required planning time (the test is to be carried out by an independent 3<sup>rd</sup> party holding respective accreditation, which usually comes from overseas) as well as customs check of the equipment, etc. can easily delay execution of the test. This means that although once every year either QAL2 or AST shall be conducted the actual time period between 2 consecutive performances is not mandatorily bound to strictly one year (365 days) but allows for some tolerance. Nevertheless, under consideration of operating conditions and practical reasons it is generally aimed on performing the tests one to another as close to one year as possible.

<sup>14</sup> Please see footnote 13 for additional comment on frequency of QAL and AST measurements



and who performs the calibration service. Calibration certificates will be retained for all meters until two years after the end of the crediting period.

#### *Archiving of data*

The monitoring team will periodically archive data to a secure and retrievable storage format on a periodic basis. This step of data archiving can also be implemented as an automated routine within the data collection unit. Calibration records may be archived by scanning and storage in an accessible electronic format. These data will be stored until 2 years after the end of the crediting period or the last issuance of CER's whichever occur later.

#### *Document Control*

The Project Manager will implement a document control system that ensures that the current versions of necessary documents are available at the point of use. All documents must be maintained in English with local translations (if necessary) because English is the formal language of the CDM.

#### *Preparation of monitoring report*

The archived / live data will be used to prepare a periodic monitoring report to be submitted to the UNFCCC secretariat for verification and issuance of CERs. An internal technical review process will be conducted and documented before such a report will be submitted for verification.

#### *Data recording system*

The CDM Project Manager will implement a data recording system for collection and archiving of the monitoring raw data. The data recording frequency for the continuously monitored parameters is 2 seconds. From these raw data hourly average values are calculated automatically.

#### *Treatment of missing or corrupted data*

If data for either the N<sub>2</sub>O concentration the volume or mass flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N<sub>2</sub>O concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the N<sub>2</sub>O concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of N<sub>2</sub>O calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut down shall not be used for the determination of the maximum values.

Similar provision may apply for the CH<sub>4</sub> inflow and the nitric acid produced. If data for the CH<sub>4</sub> inflow is not available for more than 1/3 of any hour while the plant was in operation, the value for that hour



shall be replaced with the maximum value of CH<sub>4</sub> inflow observed during the monitoring period. In case of missing hourly data for the nitric acid produced in the monitoring period  $n$  ( $P_{NA,n}$ ) the value will be replaced by a nitric acid production value from another source of data e. g. measurements of nitric acid storage tank levels in combination with a production – consumption mass balance. Only in the case that there should be no other reliable data source available the missing value should be replaced with the lowest measured value during plant operations of that monitoring period. Values observed during five operating hours before and after a plant start-up and shut down shall not be used for the determination of the maximum and minimum values.

#### *Audit function and management review*

The Project Manager will arrange for an internal audit of the management system once per year. The auditor will not be involved in the daily operation of the plant and if necessary, may be sourced from a third party. The auditor will assess the implementation of the monitoring procedure, quality assurance steps and data collection and archiving. Audit findings, and steps taken to address findings will be recorded and reviewed in a Management Review meeting (convened at least annually) at which time the effectiveness of these procedures will be reviewed and necessary changes implemented

#### **B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)**

| Company                             | Responsibility                            | Project Proponent |
|-------------------------------------|---|-------------------|
| N.serve Environmental Services GmbH | Mr. Wolfgang Brückner, Project Manager    | Yes               |
| Fatima Fertilizer Company Limited,  | Mr. Mahmood Ali, Nitric Acid Unit Manager | Yes               |

Date of completion: 28/07/2011

#### **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:**

>>

The starting date of a CDM project activity is the earliest date at which either the implementation or construction or real action of a project activity begins. The start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity.



In the light of the above definition the project start date is set as per the date when the purchase contract of the ENVINOx N<sub>2</sub>O abatement system was signed.

Starting date of the project activity: 26/10/2007

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

&gt;&gt;

The nitric acid plant has a remaining operational lifetime of at least twentyfive (25) years and zero (0) months and is not expected to be decommissioned before that time. The project activity is expected to have a minimum life time of ten (10) years and zero (0) months.

**C.2 Choice of the crediting period and related information:**

The project participants have chosen a fixed term crediting period of ten (10) years and zero (0) months.

**C.2.1. Renewable crediting period**

&gt;&gt;

N/A

**C.2.1.1. Starting date of the first crediting period:**

&gt;&gt;

N/A

**C.2.1.2. Length of the first crediting period:**

&gt;&gt;

N/A

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

&gt;&gt;

01/12/2011 or the day of the registration of the project at UNFCCC whichever occurs later.

**C.2.2.2. Length:**

&gt;&gt;



Ten (10) years and zero (0) months

#### SECTION D. Environmental impacts

##### D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

>>

The project will reduce gaseous emissions of nitrous oxide (N<sub>2</sub>O) from the plant tail gas and will therefore contribute to international efforts to reduce greenhouse gas emissions. The project will have no effects on local air quality.

The project will have no impact on water pollution. No additional water is required for the project activity's implementation or operation. Therefore, there is no impact on the sustainable use of water.

The contributions to sustainable development from the project activity are as follows:

- The project will reduce about 98% of existing N<sub>2</sub>O emissions during the crediting period and thus contributes to reducing the negative impact on global climate change.
- The technology will be introduced to the project, promoting the application of advanced emission reduction technology in Pakistan.
- The implementation of the project activity includes the training course for operation of the total unit of a tertiary catalyst unit including guidance on accurate monitoring, which will provide the staffs of Fatima Fertilizer with an opportunity to improve skills.
- The implementation of the project activity might create local employment.

##### D.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:

>>

**Fatima Fertilizer Company Limited.** has constructed a large scale fertilizer complex comprising several production facilities such as:

- One ammonia plant (1,500t/day);
- One urea fertilizer plant (1,500t/day);
- One nitric acid plant (1,500t/day<sup>15</sup>, relocated from Immingham UK);
- One CAN fertilizer plant (1,400t/day);
- One NPK fertilizer plant (1,000t/day) and

<sup>15</sup> The amounts of nitric acid mentioned here and forthcoming are calculated at 100 percent of nitric acid concentration to ensure comparability of the data as the actual concentration of the weak nitric acid produced may vary during the production campaigns.





- One NP fertilizer plant (1,200t/day).

All of the manufacturing units are covered by an Environmental permit which has been issued for the entire complex on 18/08/2010.

EIA number: NO.DD(EIA)/EPA/F-67/(EIA)/2007/218/562

Thus, an Environmental Impact Assessment (EIA) is not required for implementing the planned CDM project activity.

#### **SECTION E. Stakeholders' comments**

The full documentation of the stakeholder process was provided to the DOE during the on-site visit of the validation.

##### **E.1. Brief description how comments by local stakeholders have been invited and compiled:**

>>

Stakeholders have been invited for comments and for participation at the local stakeholder consultation by publishing public notices in different national newspapers of Pakistan one week prior to the scheduled meeting on 18/07/2011 at 11.00 am. As per schedule the meeting was held at Fatima Fertilizer Company Limited site. The participants were given a summary on the process and the objectives of the underlying CDM-project activities and were invited to ask and comment on the impacts of the proposed project. About 300 people used the opportunity to attend the meeting and discussed the project. Experts of Fatima's fertilizer plant lead the discussion and were giving answers in case of questions.

1. Evidence of invitation in different Pakistani newspapers



Figure 6: Examples for the announcement of the local stakeholder consultation in different Pakistani newspapers

## 2. Photographs of the stakeholder consultation



Figure 7: photographs of the stakeholder consultation of the project activity

### E.2. Summary of the comments received:

>>

The general opinion towards the project activity was encouraging and positive. None of the stated comments were opposing the project activity itself. Only a few questions were received during the meeting, which could be answered by the local staff. Those questions mainly regarded the impact of N<sub>2</sub>O on climate change and on human health.

Full documentation of the comments received during the meeting will be provided during onsite visit of the validation.

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

>>

Questions received were answered and written down manually. No relevant comments were received which therefore did not impose the need to adapt the project design.

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

|                   |  |
|-------------------|--|
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|                  |  |
|------------------|--|
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**Annex 2**

**INFORMATION REGARDING PUBLIC FUNDING**

No public funds are used for this project activity.



**Annex 3**

**BASELINE INFORMATION**

Not applicable





**Annex 4**

**MONITORING INFORMATION**

See Section B.7.2.

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