JOINT IMPLEMENTATION PROJECT DESIGN DOCUMENT FORM
Version 01 - in effect as of: 15 June 2006

CONTENTS

Annexes

SECTION A. General description of the project

A.1. Title of the project:

YARA Köping S3 N_2O abatement project in Sweden
Version: 2nd September 2011 (Version #8)
Sectoral scope: 5 – Chemical Industry

A.2. Description of the project:

The sole purpose of the proposed project activity is to significantly reduce current levels of N_2O emissions from the production of nitric acid at YARA's nitric acid plant Syra 3 at Köping, Sweden.

The nitric acid plant was designed by Uhde. Commercial nitric acid production started in 1982. It is a 4.8 bar medium/high pressure plant with a daily design production output of 418 metric tonnes of HNO_3 (100% conc.) per day[1]. YARA Köping S3's design production campaign is 180 days. Depending on whether or not the plant is shut down for maintenance purposes or exchange of the primary catalyst gauzes, the plant is operated for around 348 days per year, resulting in a theoretical maximum annual production output of up to 145,464 $tHNO_3$[2].

To produce nitric acid, ammonia (NH_3) is reacted with air over precious metal – normally a platinum-rhodium- (Pt-Rh) alloy – catalyst gauze pack in the ammonia oxidation reactor (AOR) of the nitric acid plant. The main product of this reaction is NO, which is metastable at the conditions present in the ammonia oxidation reactor and therefore it reacts with the available oxygen to form NO_2, which is later absorbed in water to form HNO_3 – nitric acid. Simultaneously, undesired side reactions yield nitrous oxide (N_2O), nitrogen and water. N_2O is a potent greenhouse gas with a Global Warming Potential (GWP) of 310[3]. The plant currently emits an average of 7.99$kgN_2O/tHNO_3$[4], which means that the continued operation of the plant without any N_2O abatement technology installed could theoretically entail emissions of as much as 360,300 tCO_2e annually.

The project activity involves the installation of a new N_2O abatement technology: a pelleted catalyst that will be installed inside the Ammonia Oxidation Reactor (AOR), underneath the precious metal gauzes. It is expected that this catalyst will reduce approximately 90% of current N_2O emissions on average over its lifetime.

The N_2O abatement catalyst applied to the proposed project has been developed by YARA. Industrial trial runs have been undertaken at various YARA plants (mainly in France) over the last four years. By now, the YARA management considers the technology as sufficiently mature for full application in nitric acid plants.

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[1] The plant was originally designed for 370t HNO_3/day, but several modifications have been made since 1982 that have led to an increase in production capacity. The design total gas volume flow into the AOR (the flow of NH3 and air mixture) has increased from 70,436kg/h in the original operating manual to 79,594kg/h, which is the principal reason for the plant's increase in production capacity to 418t/day. This increased design volume flow can be confirmed by the updated plant design specification from Steinmüller Engineering following the waste-heat boiler replacement in April 2005. It can be seen from the updated plant process flow-sheet "Aspen Plus 23.0 Run: max_air_ver10" that the nominal plant capacity has increased, The process flow sheet is based on the specifications listed by Steinmüller.

[2] See also section E.5 for information regarding the cap that will be applied to HNO_3 production eligible to receive ERUs.

[3] IPCC Second Assessment Report (1995); applicable according to UNFCCC-decision 2/CP.3, paragraph 3. After 2012 the GWP of N_2O will be 298, as defined by the IPCC Fourth Assessment Report in connection with Art 5 paragraph 3 Kyoto Protocol.

[4] See section A 4.3.1 for details

For monitoring the N_2O emission levels, YARA Köping S3 will install and operate an Automated Monitoring System according to EU standards[5].

YARA Köping adheres to ISO 9001 and ISO 14001 management standards[6] and will implement procedures for monitoring, regular calibrations and QA/QC in line with the requirements of these standards.

A.3. Project participants:

Party involved (*) **((host) indicates a host Party)**	**Legal entity project participant (as applicable)**	**Please indicate if the Party involved wishes to be considered as project participant (Yes/No)**
Sweden (host)	• YARA AB (Sweden)	No
Netherlands	• N.serve Environmental Services GmbH (Germany)	No

This project will be developed as an independently-verified JI Project activity in accordance with UNFCCC decision 9/CMP.1, paragraph 24. The project will be developed under Track 2 JI, since the Swedish government has decided not to undertake Track 1 projects.

A.4. Technical description of the project:

A.4.1. Location of the project:

A.4.1.1. Host Party(ies):

Sweden

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

Köping Municipality

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

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[5] See section D.1 for detailed information.

[6] All quality management documents are stored on the internal YARA Koping database and will be made available to the AIEs upon request.

Köping

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

Plant address:
P.O Box 908
SE - 73129
Köping
Nya Hamnvägen 14
SWEDEN

The pictures below illustrate the location of the plant:

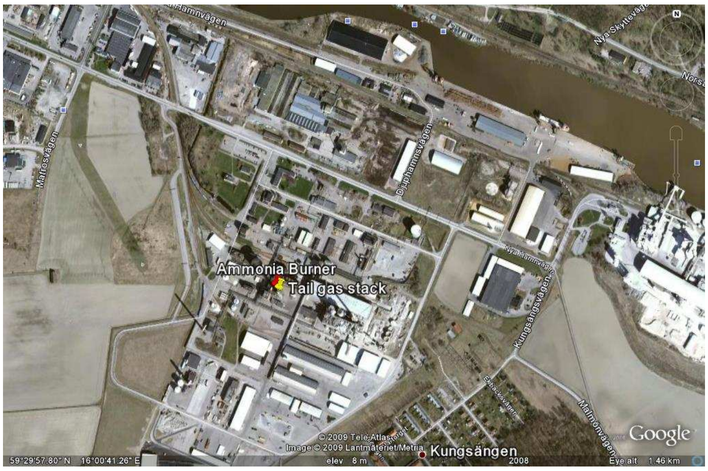

Figure 1: Location of YARA Köping S3 plant

Figure 2: Close up image of YARA Köping S3 plant

Plant Coordinates[7]:
Ammonia burner: 59°29’53.71”N & 16°00’28.99”E

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[7] Coordinates according to Google Earth©

Tail gas stack: 59°29’53.40”N & 16°00’29.42”E

A.4.2. Technology(ies) to be employed, or measures, operations or actions to be implemented by the project:

The main parts of the plant as currently set up are the ammonia burner inside which the ammonia oxidation reaction takes place, the absorption tower where the gas mix from the burner is led through water in order to form nitric acid and the stack through which the off-gasses are vented into the atmosphere.

The precious metal gauze pack – i.e. the primary catalyst required for the formation of NO in the first step of the nitric acid production process – is manufactured by KAR Rasmussen, located in Norway and the same primary catalyst composition and supplier will continue to be used throughout the project crediting period

The project activity entails the implementation of:

- N_2O abatement technology, until recently only applied on industrial trial level within the European Union, that will be inserted into the ammonia oxidation reactor; and
- Specialised monitoring equipment to be installed at the stack (detailed information on the AMS is contained in section D.1).

Catalyst Technology

A number of N_2O abatement technologies have become commercially available in the past 4 years after several years of research, development and industrial testing. Since the end of 2005, many CDM project activities employing various kinds of N_2O abatement catalysts have been registered with the CDM EB. But these activities are of course limited to plants located in developing nations.

Due to lack of incentives for voluntary reductions before 2008 and the absence of legal limits on industrial N_2O emissions in nearly all the European Union member states, the vast majority of EU-based plant operators have so far not invested in N_2O abatement devices. YARA International ASA (Norway) is a noteworthy exception to this general rule, because the company conducted long term industrial trial runs of its self-developed catalyst system YARA58 Y 1 ® in various plants, mainly in France, since 2005.

The plant operated by YARA Köping S3 has also been part of this catalyst industrial trial programme and had a partial batch of test catalyst installed from May 2007 (850kg). Due to potential operational problems associated with installing abatement catalyst, the YARA management decided not to fill the catalyst containment system to its maximum capacity during the research and testing phase. However, since the catalyst is now installed all over the world in many CDM and JI projects and its capabilities have been extensively proven, these industrial trial runs are now considered complete and are no longer necessary. Since the catalyst was nearing the end of its useful life, it was removed during a regular shutdown in November 2009 and not replaced, i.e. the plant is currently operating without any N2O abatement installed.

However, participation in a JI project offers a real incentive to install and operate a full batch of secondary catalyst after the industrial trials have come to an end and to achieve the maximum emissions reductions possible from this catalyst. Following the measurement of a historic baseline to establish the factual emissions of the plant in the absence of any N_2O abatement technology, the basket will be filled with a new batch of catalyst (approx 1400kg) to achieve optimum abatement of N_2O.

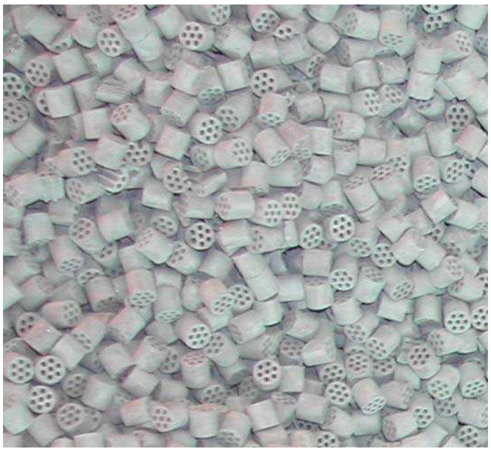

Figure 2: Close up image of Yara secondary catalyst

YARA Köping S3 will install the YARA catalyst system, consisting of an additional base metal catalyst that is positioned below the standard precious metal gauze pack in the ammonia burner. Operation with a full batch of catalyst installed is expected to start at the beginning of May 2010. The exact date is yet to be confirmed.

A secondary catalyst will reduce N_2O levels in the gas mix resulting from the primary ammonia oxidation reaction. A wide range of metals (e.g. Cu, Fe, Mn, Co and Ni) have shown to be of varied effectiveness in N_2O abatement catalysts. The YARA abatement catalyst is made of cylindrical pellets containing cobalt as an active ingredient. The abatement efficiency has been shown to be more than 90% in the following reaction:

$$2\ N_2O \rightarrow 2N_2 + O_2$$

If operated properly, the secondary catalyst system may significantly reduce N_2O emissions for up to three years before the catalyst material needs to be replaced.

The YARA abatement catalyst has been proven by industrial testing not to have any positive effect on plant production levels[8]. Also, only traces of the catalyst material at concentrations of parts per billion could be found in the nitric acid product[9].

No additional heat or other energy input is required, because the temperature levels present inside the ammonia oxidation reactor suffice to ensure the catalyst's optimum abatement efficiency. There are no additional greenhouse gases or other emissions generated by the reactions at the N_2O abatement catalyst.

N_2O abatement catalyst installation

The secondary catalyst itself can easily be installed during a routine plant shut-down and gauze change. The pellets are poured into the support basket / perforated plate arrangement and levelled. The gauze pack is then installed above the levelled catalyst pellets.

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[8] See the European IPPC Bureau publication „Integrated Pollution Prevention and Control; Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilizers (August 2007), page 124 therein.

[9] This has been proven in industrial testing. The underlying information is commercially sensitive and will be made available to the AIE mandated with the determination procedure upon request. General information on this question is contained in the European IPPC Bureau publication „Integrated Pollution Prevention and Control; Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilizers (August 2007), page 124 therein (available for downloading under http://eippcb.jrc.ec.europa.eu/pages/FActivities.htm)

After the end of its useful life, the catalyst will be refined, recycled or disposed of according to EU regulations.

YARA's Köping S3 nitric acid plant operates at a pressure of around 4.8 bars inside the ammonia oxidation reactor. Through the introduction of the secondary catalyst into the ammonia reactor, a slight pressure drop (ΔP) is expected to occur. This ΔP may lead to a slight reduction in ammonia conversion efficiency and hence a very small reduction in nitric acid output. In practice, this loss of production is likely to be insignificant.

Technology operation and safety issues

As mentioned before, the secondary abatement technology has been tested in several industrial trials and has proven to be a reliable and environmentally safe method of reducing N_2O.
Once installed, the catalyst and the AMS will be operated, maintained and supervised by the employees of YARA Köping according to standards that are normally used in the European industry[10].
Due to the long-term catalyst development phase, there is expert know-how readily available within the YARA group. Therefore, YARA Köping is very confident that the effective operation of the catalyst technology, the operation of the monitoring system and the data collection, storage and processing can be managed in accordance with the JI requirements. Adherence to the applicable standards will be ensured by a thorough training session for the YARA employees involved.

A.4.3. Brief explanation of how the anthropogenic emissions of greenhouse gases by sources are to be reduced by the proposed JI project, including why the emission reductions would not occur in the absence of the proposed project, taking into account national and/or sectoral policies and circumstances:

Without JI participation (and therefore in a 'Business as Usual' scenario), emission levels would:

- Remained unchanged until end of December 2012, because:
    - there is currently no legal requirement for YARA Köping to reduce the emissions of its plant;
    - implementing N_2O reduction catalyst technology requires significant investments and may result in some technical difficulties with regard to the plant's operation, potentially even causing a reduction in production output; and
    - implementing N_2O catalyst technology does not yield any other benefits besides potential revenues from ERU sales.

- Be reduced from 1st January 2013, because:
    - It is highly possible that N2O emissions from nitric acid plants could be covered under the EU ETS[11]

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[10] See section D.3 below.

[11] On 23rd January 2008, the EU Commission published a communication on its post-2013 climate change strategy (see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0035:FIN:EN:PDF), which announces the determination to expand the EU ETS beyond its present scope, especially mentioning the inclusion of non-CO_2 gasses into the system. This development is no news to the industry, because responding to Article 30 of the EU ETS Directive 2003/87/EC, the Commission had submitted a report to the European Parliament and the Council considering the inclusion of non-CO_2 GHGs into the EU ETS already in November 2006. See the EU homepage under http://ec.europa.eu/environment/climat/emission/pdf/com2006_676final_en.pdf for this report which expressly considers extending the EU ETS into N_2O emissions (see page 6 therein).

- Yara Köping S3 agreed with the Swedish Environmental Protection Agency that they would reduce emissions in 2013 to meet the value of 2.5kgN_2O/tHNO_3 (which is the so-called 'split view' opinion resulting from the IPPC BAT reference document).

More detail on these assumptions will be provided in section B.2 below.

A.4.3.1. Estimated amount of emission reductions over the crediting period:

The following paragraph describes the estimated emission reductions achievable by the project activity.

Nitric acid production and estimation of baseline emissions

The factual emission reductions depend on the factual emissions of the plant prior to installation of the catalyst and the amount of nitric acid produced. In accordance with AM0034 (ver 03.4), emission reductions are determined per unit of product measured in metric tonnes of 100% concentrated nitric acid produced.

At YARA Köping S3, the nitric acid production is calculated by means of a daily mass balance calculation that takes into account the NH_3 consumption of the plant, the weight of solid ammonium nitrate produced from the nitric acid, and the weight of nitric acid that is exported off-site. This is then double-checked against HNO_3 tank level measurements and readings taken by an HNO_3 flow meter.

Table 1 below displays the historic nitric acid production at the Syra 3 plant between the years 1990 and 2009.

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
tHNO3 (Kt)	113	118	119	125	117	128	129	127	129	130
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
tHNO3 (Kt)	132	129	133	127	124	119	134	133	132	131

Table 1: Historical nitric acid production figures

Table 2 below displays the expected nitric acid production amounts for the years 2010 to 2012 and the estimated N_2O emissions in the absence of a secondary abatement catalyst.

For three campaigns from June 2005 to April 2007, prior to the implementation of the secondary catalyst for industrial trials, spot measurements taken at the plant showed an average N_2O concentration of 1278ppm, which is equal to 7.99kgN_2O/tHNO_3. The measurements were taken with a 'Rosemount Gaslog 800' measuring device, which will be replaced with an EN14181-compliant analyser for the purposes of the project activity.

Since the baseline emissions factor is not yet available at the time of writing this PDD, this 'preliminary' baseline emissions factor of 7.99kgN_2O/tHNO_3, in conjunction with the predicted abatement efficiency of the catalyst (90%), will be used in this PDD in order to make realistic assumptions on the likely baseline and project emissions factors that might be expected during the baseline and project campaigns respectively.

Year	Nitric acid production (based on max of past years) ($tHNO_3/y$)	Preliminary baseline Emissions factor ($kgN_2O/tHNO_3$)	Expected baseline emissions (tCO2e/yr)
2010 (May-Dec)	89,333	7.99	221,270
2011	134,000	7.99	331,905
2012	134,000	7.99	331,905
Following years	134,000	7.99	331,905

Table 2: Expected nitric acid production and estimated baseline N_2O emissions at Köping S3

Accordingly, the **following assumptions** apply to the establishment of the emissions reductions eligible to receive ERUs:

- The project activity starts on 1st May 2010;
- YARA Köping S3 produces the amounts of nitric acid according to the production budget provided above, each year's production being equally distributed throughout the period;
- The secondary catalyst employed performs with an expected abatement efficiency of 90% throughout the project's lifetime (resulting in an average project emissions factor of 0.8kg $N_2O/tHNO_3$).
- The ERU figures included in this PDD are *estimations* only. ERUs will therefore be awarded for those factual emissions reductions actually achieved below the UNC-corrected baseline emissions factor and subsequently verified by the responsible AIE, and *not* in accordance with the preliminary estimations provided in this PDD.
- During the discussion period prior to the issuance of the most recent environmental permit, Yara Köping S3 reached an agreement with the Swedish EPA to reduce its emissions in the year 2013 to 2.5kg $N_2O/tHNO_3$, which is the so-called 'split view' factor resulting from the IPPC BAT reference document. In the unlikely event that N_2O is not covered under the EU ETS in the year 2013, the 'baseline' emissions from the 1st January 2013 onwards would therefore be represented by the value 2.5kg $N_2O/tHNO_3$ and ERUs would only be awarded for those emissions reductions that are achieved below this value.

In the case of introduction of national or local regulations that would limit N_2O emissions at Köping S3, ERUs would be awarded only for those emissions reductions that take place below the new regulatory level, in accordance with Methodology AM0034, ver 03.4.

The following tables 3 and 4 display the emissions reductions expected during the crediting period[12]. *Please note that all figures in the calculation tables have been rounded to the nearest tonne of CO2e. In view of the fact that the figures link directly to a detailed excel spreadsheet, the final total may not accord completely with the preceding figures.*

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[12] The values indicated in the tables also take into account the estimated uncertainty of the Automated Monitoring System (UNC); this UNC deduction is explained in more detail in section D.1.2.2. A conservative UNC of 5% has been used for the calculations in this PDD, but in reality this is expected to be slightly lower.

Crediting Period (year)	Estimate of annual emissions reductions in tonnes of CO2 equivalent
2010 (May to Dec)	188,038
2011	282,057
2012	282,057
Total estimated emission reductions over the crediting period until end 2012 (tonnes of CO2 equivalent)	**752,151**
Annual average of estimated emissions reductions over the crediting period until end 2012 (tonnes of CO2 equivalent)	**282,057**

Table 3(part A): Estimated emission reductions until 2012 (with AMS UNC deduction)

Crediting Period (year)	Estimate of annual emissions reductions in tonnes of CO2 equivalent
2013	67,884
2014	67,884
2015	67,884
2016	67,884
2017	67,884
2018	67,884
2019	67,884
Total number of crediting years	10
Total estimated emission reductions over the 10-yr crediting period (tonnes of CO2 equivalent)	**1,227,342**
Annual average of estimated emissions reductions over the 10-yr crediting period (tonnes of CO2 equivalent)	**122,734**

Table 4 (part B): Estimated emission reductions from 2013 onwards (with AMS UNC deduction)

* Due to the likely inclusion of N_2O emissions emanating from nitric acid production into the EU ETS from 1st January 2013 onwards, the project may not be eligible to earn ERUs after that time, or continuing the project under the JI may not be economically viable. Also, from 2013 onwards a GWP of 298 for N_2O, as defined by the IPCC Third Assessment Report, will be applied. This is why this PDD differentiates between prospective emission reductions achieved until 31st December 2012 and emissions reductions generated from 1st January 2013 onwards.

A.5. Project approval by the Parties involved:

The Swedish government has decided that JI projects to be undertaken on Swedish territory should be implemented in accordance with the JI Track 2 procedures. The project proponents submitted on 12th October 2009 a Project Idea Note (PIN) to the Swedish DFP (Swedish Energy Agency) and requested a

Letter of Endorsement (LoE). The DFP issued a LoE for the project on 11th November 2009, stating that they do not have any objections to the realisation of the planned JI project.

A final decision by the DFP regarding approval of the JI project (in the form of an official Letter of Approval) will be taken only after the final PDD and Determination Report have been submitted to the DFP.

Once approval is received from the host country DFP, the project participants will apply for an investor country LoA.

A copy of both host and investor country LoAs will be made available to the determining AIE and the project documentation will then be submitted to the JI Supervisory Committee for approval and final registration of the project.

SECTION B. Baseline

B.1. Description and justification of the baseline chosen:

This project is based on Approved Baseline and Monitoring methodology AM0034 (Version 03.4): “Catalytic reduction of N_2O inside the ammonia burner of nitric acid plants”.

Furthermore, the project draws on approved baseline methodology AM0028 (Version 04.2) for the baseline scenario selection and employs the “Tool for the demonstration and assessment of additionality” (Version 05.2).

Applicability of AM0034 ver 03.4

The CDM methodology AM0034 (ver 03.4) is applicable to project activities aiming to install secondary N_2O abatement at a nitric acid plant. YARA Köping S3 consists of one ammonia burner feeding into one absorption tower and the off-gasses are emitted through one stack. The secondary N_2O catalyst system will be inserted into the ammonia reactor during a routine shut down; the abatement system is installed underneath the primary catalyst gauzes. This corresponds to the defined scope of the methodology.

Furthermore, the additional applicability criteria of the chosen methodology are met by the proposed project activity. These are:

1. The proposed project activity will be applied to production facility that was operated for commercial nitric acid production before the 31st December 2005 (based on design capacity installed). Definition of existing production capacity is applied for the process with the existing ammonia oxidization reactor where N_2O is generated and not for the process with new ammonia oxidizer.

   The waste heat boiler inside the ammonia oxidation reactor was replaced by a new one in April 2005, but the ammonia oxidation reactor itself was not replaced. Köping S3 has a daily design production output of 418tHNO_3/day. The plant is operated for around 348 days per year, resulting in an annual design capacity of 145,464 tHNO_3. For more details on the plant’s design capacity, please see footnote 1.

2. Currently, no N_2O abatement technology is installed in the plant that could be affected by the project activity.

   As described in section A.4.2 above, Köping S3 previously had a partial batch of test catalyst installed for industrial trials. However, these industrial trial runs are now considered complete and are no longer necessary. Since the catalyst was nearing the end of its useful life, it was removed in the shutdown in November and not replaced.
3. The project activity has no influence on the plant’s nitric acid production levels.

   It has been proven by industrial testing that a plant’s production levels are not affected by the installation of a secondary N_2O catalyst[13].
4. The host country does not have any legal requirements to reduce N_2O emissions from nitric acid plants.

   Swedish environmental legislation, be it on national or local level, currently does not limit N_2O emissions.
5. The project activity will not increase NO_X emissions.

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[13] See the European IPPC Bureau publication „Integrated Pollution Prevention and Control; Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilizers (August 2007), page 124 therein.

The secondary catalyst technology to be installed has no effect on NO_X emission levels. This has been scrutinised in industrial testing over extended industrial process application[14]. In addition, the regular and compulsory NO_X tests conducted by YARA, and reported to the responsible local environmental authority, would reveal any changes in NO_X emission levels.

6. There is no NSCR $DeNO_x$-unit installed in the plant.

   No NSCR technology is installed at the plant. The plant is in compliance with its NO_X-emission limits, thanks to its existing SCR de-NOx unit.

7. Continuous real-time measurement of the N2O concentration and total gas volume flow can be carried out in the stack:

   - Prior to the installation of the secondary catalyst for one campaign
   - Following installation of the secondary catalyst throughout the chosen crediting period of the project activity

Regulatory framework

The regulatory framework for implementing JI projects in Sweden is influenced by several acts of law. The fundamental framework is provided by the Kyoto Protocol to the United Nations Framework Convention on Climate Change (“UNFCCC”) and subsequent decisions by UNFCCC-entities, most importantly the decisions of the Conference of the UNFCCC Parties serving as the Meeting of Parties to the Kyoto Protocol (“CMP”) and the Joint Implementation Supervisory Committee (“JI SC”).

In addition, there is the European Union legislation adapting the Kyoto JI framework for application in its member states such as the Emissions Trading Directive[15], the Linking Directive[16] and various JI relevant decisions by EU bodies[17]. Besides acts of law of direct relevance, there are also Directives that have an indirect influence on JI implementation such as the IPPC Directive[18].

EU Directives do not entail direct consequences on private entities located in the EU member states. In order to be enforceable on member state level, they generally have to be transformed into national legislation by the respective member state. These national transformation acts, as well as other national legislation, are the third layer of the regulatory framework relevant for JI project implementation. In Sweden, the most relevant transformation laws are the ‘Ordinance amending the Emissions Trading Ordinance (2004:1205)’, dated 31st August 2006, and the ‘Regulation concerning project based mechanisms under the Kyoto Protocol’, dated 18th October 2006.

Sweden has opted to follow JI Track 2 for the implementation of its JI projects.

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[14] See the European IPPC Bureau publication „Integrated Pollution Prevention and Control; Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilizers (August 2007), page 124 f. therein. This source states that NO yields for the ammonia oxidation reaction remain unchanged when operating secondary N_2O abatement catalysts.

[15] 2003/87/EC, published on the internet under http://ec.europa.eu/environment/climat/emission/implementation_en.htm

[16] 2004/101/EC, published on the internet under http://ec.europa.eu/environment/climat/emission/implementation_en.htm

[17] Such as the Double Counting decision 2006/780/EC, published on the internet under http://ec.europa.eu/environment/climat/emission/pdf/l_31620061116en00120017.pdf

[18] 2008/1/EC, published on the internet under http://ec.europa.eu/environment/air/pollutants/stationary/ippc/index.htm

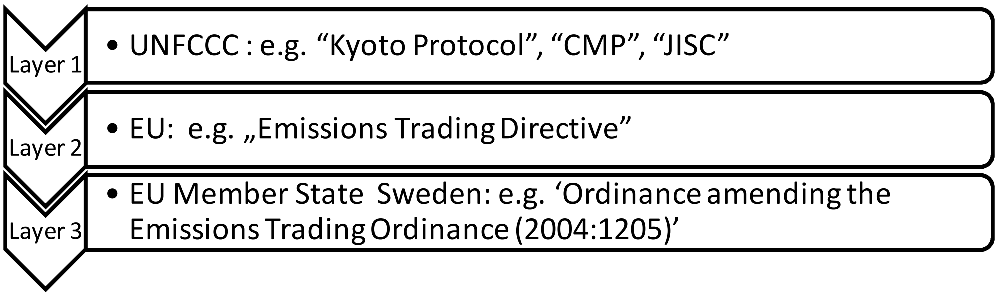

Illustration: Three layers of jurisdiction relevant for the implementation and subsequent operation of N2O nitric acid JI projects in Sweden

The JI SC has specified that JI project proponents may choose between two options when implementing JI projects: they may either (i) use a multi project emission factor (ii) or establish a project specific baseline[19]. Due to the significant variances typically observable in different nitric acid plants, it would not be appropriate to derive a multi-project emission factor. Instead, the project proponents will measure a project-specific historic baseline, as defined in AM0034, ver 03.4.

Identification of the baseline scenario

The approved baseline methodology AM0034 (Version 03.4) refers to AM0028 (Version 04) with regard to the identification of the baseline scenario. Furthermore, the following steps are based on the “Combined Tool to identify the baseline scenario and demonstrate additionality” (Version 02.2)[20].

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_2O emissions. These options are, inter alia:

- Status quo: The continuation of the current situation
- Switch to alternative production method not involving ammonia oxidation process;
- Alternative use of N_2O such as:
  - Recycling of N_2O as a feedstock for the plant;
  - The use of N_2O for external purposes.
- Installation of a Non-Selective Catalytic Reduction (NSCR) DeNOx unit;
- The installation of an N_2O destruction or abatement technology:
  - Tertiary measure for N_2O destruction;
  - Primary or secondary measures for N_2O destruction or abatement.

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[19] The requirements for this approach are outlined in the 4th JI SC Meeting Report, Annex 6 “Guidance in the Criteria for Baseline Setting and Monitoring” (Version 01), section B; paragraphs 18 ff. (see the internet under http://ji.unfccc.int/Sup_Committee/Meetings/index.html for reference).

[20] AM_Tool_02, provided by the CDM EB in its 28th Meeting; published on the UNFCCC web site under http://cdm.unfccc.int/Reference/tools/index.html

These options should include the JI project activity not implemented as a JI project.

1.1 Assessment and continuation of the current situation, the "Status Quo"

A partial batch (850kg) of N_2O abatement catalyst was installed in YARA Köping S3 for the past two and a half years as part of an industrial research and development programme. However, since the catalyst is now already installed in many plants around the world in projects implemented under the CDM and JI and its performance has been adequately proven, this industrial testing phase is now considered complete and is no longer necessary.

Since the catalyst was nearing the end of its useful life, Yara removed the catalyst in the November 2009 shutdown, since the date of the following shutdown (and next opportunity for catalyst removal) was uncertain at that time. Since there is currently no regulation limiting N_2O emissions at nitric acid plants in Sweden, there was no need to replace the catalyst after its removal in November 2009.

The reference case 'business as usual' scenario (and the Status Quo) would therefore be the operation of the plant without any N_2O abatement technology until the end of 2012, following the removal of the previous batch of trial catalyst at the end of the industrial trials in November 2009.

1.2 Switch to alternative production method not involving ammonia oxidation process

Changing the production process would require setting up a new production facility, because the present plant cannot be amended to employ a different production procedure. Choosing another production procedure would also not be state-of-the-art, because the current operating procedures are the most advanced available.

1.3 Alternative use of N2O, such as:

- Recycling of N2O as a feedstock for the plant

The use of N_2O as a feedstock for the production of nitric acid is not feasible, because it is not possible to produce nitric acid from N_2O at the quantities emitted during nitric acid production.

- The use of N2O for external purposes

The use of N_2O for external purposes is not practised anywhere in the world, as it is technically and economically unfeasible. The quantity of gas to be used as a source is enormous compared to the amount of nitrous oxide that could be recovered. The average N_2O concentration in the tail gas of the Köping S3 plant during standard operation without any abatement catalyst would be over 1270 ppmv[21], which is considered far too low to economically recover and separate from the tail gas.

1.4 Installation of a Non-Selective Catalytic Reduction (NSCR) De-NOx unit (step 1b);

The NSCR scenario alternative could be triggered by NO_X regulation. From this perspective, YARA Köping S3 could be reducing N_2O in a business as usual scenario if NO_X regulation forced the plant operators to install NSCR technology. Such technology would be useful for reducing NO_X emission levels, but would also lower N_2O emissions.

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[21] This value is derived from the average N_2O emissions readings taken at Koping S3 over three full campaigns between 2005 and 2007, prior to secondary catalyst installation.

However, the installation of a Non-Selective Catalytic Reduction (NSCR) de-NO_X catalyst unit is uneconomic, because a) an NSCR is generally not considered the best available technology for NOx abatement and b) YARA Köping S3 is already in compliance with the prevailing NO_X regulations[22]. The EFMA BAT reference document explains that an NSCR functions by injecting hydrogen, natural gas or hydrocarbons over a precious metal based catalyst, leading to high investment and operational costs. The use of hydrocarbons as a reducing agent also results in emissions of carbon monoxide, CO_2 and unburned hydrocarbons. Also, NSCR units require very high tail gas temperatures to be able to function. By being led through the absorption tower the gas mix has been cooled down to a temperature level below that required for NSCR abatement catalysts to function[23]. Because of this, an NSCR abatement system would only work if the stack gas mix is re-heated[24].

If even lower NO_X levels were introduced, the most economical option would instead be to upgrade the existing SCR NO_X abatement unit already installed at the plant. However, YARA Köping S3 is currently achieving NO_X-emission levels in line with the applicable limit of 100 ppm. The regulatory levels would therefore need to be lower in order to enforce any additional adaptation requirements upon YARA Köping S3. If a lower limit is introduced, a re-assessment of the baseline scenario may be necessary in accordance with step 5 below.

As the existing SCR-NO_X abatement system is already efficient, there would be no point in also installing NSCR, even if this technology was considered an alternative option.

Therefore, at this stage baseline scenarios 1.2, 1.3 & 1.4 can be excluded from further assessment.

1.5 Implementation of primary, secondary and tertiary technologies

Since the primary catalyst composition is the most significant factor in determining nitric acid production efficiency and is carefully calculated to ensure a maximum production of HNO_3 at a minimum cost, producers are not willing to take any risks that may affect their nitric acid production by experimenting with different primary catalyst compositions to potentially influence N_2O levels. For the specific reduction of N_2O emissions, producers only consider installation of the already widely-tested and well-proven secondary and tertiary catalyst technologies.

Tertiary measures may be considered when building a new plant, but installation in an existing plant is rarely an economical option. It is necessary to install a complete additional reactor between the absorption column and the tail gas stack in order to house the catalyst. Since the temperature of the tail gas after the absorption column is around 25°C, the gas would need to be re-heated to a temperature high enough for the tertiary catalyst to function. Both these requirements mean that tertiary catalyst is ultimately considerably more expensive than secondary catalyst and a longer period of plant downtime is necessary in order to install the additional reactor[25].

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[22] Environmental permit 'M 481-09', dated 17th June 2010 (page 2 therein)

[23] NSCR abatement catalysts require a gas mix temperature of around 550°C in order to operate effectively; see the booklet no. 2 of the European Fertilizer Manufacturers Association (EFMA), published in the internet under http://www.efma.org/EPUB/easnet.dll/ExecReq/Page?eas:template_im=000BC2&eas:dat_im=000EAE (page 17 therein) for further information.

[24] For other disadvantages of NSCR technology see the EFMA-booklet published on the internet under http://www.efma.org/EPUB/easnet.dll/ExecReq/Page?eas:template_im=000BC2&eas:dat_im=000EAE (page 18 therein).

[25] Footnotes 22 and 23 also tend to apply to tertiary catalysts, depending on the exact type.

Step 1b: In addition to the baseline scenario alternatives of Step 1a, all possible options that are technically feasible to handle NO_X emissions should be considered. The installation of a NSCR DeNOx unit could also cause N_2O emission reductions. Therefore NO_X emission regulations have to be taken into account in determining the baseline scenario. The respective options are, inter alia:

- The continuation of the current situation, where either a DeNOx-unit is installed or not;

  An SCR De-NOx unit is installed at the plant.

- Installation of a new Selective Catalytic Reduction (SCR) DeNOx unit;

  As mentioned above in section 1.4 of Step 1a, the SCR is functioning efficiently enough to satisfy the plant's applicable NOx regulations. The plant would therefore not consider the installation of a new unit.

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

  The installation of a Non-Selective Catalytic Reduction (NSCR) de-NO_X catalyst unit is uneconomical, for the reasons explained in section 1.4 of Step 1a above.

- Installation of a new tertiary measure that combines NO_X and N_2O emission reduction.

  The installation of a new tertiary measure is uneconomical, for the reasons explained in sections 1.4 and 1.5 of Step 1a above.

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

There are currently no national and no regional regulatory limits for YARA Köping S3 in Sweden regarding N_2O emissions. However, it is compulsory for the plant to report its annual N_2O emissions to the national authorities (Naturvårdsverket) if the total emissions of the S2 and S3 plants combined exceed 10,000kg N_2O/year. The submitted figures are then made publicly available in the 'Pollutant Release and Transfer Registry' on the Naturvårdsverket website[26].

Additionally, the plant was issued with a new environmental permit number M 481-09 on the 17th June 2010. This permit does not contain any regulatory limits on N_2O emissions at Köping S3 and as such, does not represent any obligation or incentive for the plant to reduce its emissions at the present time. However, as part of the discussions between the Swedish Environmental Protection Agency and Yara Köping in the period leading to the issuance of the new permit, Köping S3 undertook to reduce its emissions in the year 2013 to a level of $2.5 kgN_2O/tHNO_3$, which is the so-called 'split view' opinion resulting from the IPPC BAT reference document.

NO_X-emissions are regulated by an operational permit for the YARA Köping S3 plant. According to the relevant Environmental permit ('M 481-09', dated 17th June 2010), the permitted level is 100ppm, as a monthly average value.

According to readings taken with the Rosemount Gaslog analyser during 2008 and 2009[27], the plant is in compliance with the requirements specified in the applicable environmental permits. YARA Köping S3's NO_X emissions will remain constant and in compliance with the regulatory limit also after the installation of the secondary catalyst. NOx emissions at Köping S3 are reported to the municipal

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[26] http://kur.naturvardsverket.se:7001/kur/search/simple/load.do#1910?locale=en

[27] NO_X-readings were provided to the AIE during the on-site Determination

authorities once per month and the national authorities (Länsstyrelse and naturvårdsverket) once per year.

In consequence, all scenarios are in compliance with all applicable laws and regulatory requirements.

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

At the next step, baseline alternatives that face prohibitive barriers are eliminated from the further baseline identification process (barrier analysis).

Sub-step 3a: On the basis of the alternatives that are technically feasible and in compliance with all legal and regulatory requirements, a complete list of barriers that would prevent alternatives to occur in the absence of JI is established.

Barriers include:

Investment barriers

The investment barriers analysis asks which of the remaining scenario alternatives is likely to be prevented by the costs associated with it becoming reality. The assumption is that these scenarios would be unlikely to be the business as usual scenario.

None of the N_2O destruction technology options (including NSCR) are expected to generate any financial or economic benefits other than JI-related income. Their operation does not create any marketable products or by-products. Plant operators would face significant investment requirements if they decided to install N_2O abatement (including NSCR) technology. Unless there is a legal obligation to reduce N_2O emission levels (NO_X limits already being complied with), there is no need to overcome these barriers. See step 1 (1.4) above for additional information on investment barriers facing NSCR technology.

Any operator willing to install and thereafter operate N2O abatement technology under the JI faces significant investment and additional operating costs:

The proposed project activity aims to install and operate secondary catalyst technology at the plant throughout the crediting period. In order to assess the project emissions, an Automated Monitoring System (AMS) has to be installed and operated. In addition to the initial investment for the expensive catalyst material and suitable AMS, Köping S3 employees and management will have a significant additional work load to cope with in order to initiate the project activity and maintain it for the project's lifetime. Required training for AMS operation has to be undertaken by the responsible staff, and AMS calibration and other JI Project-related audits have to be arranged, facilitated and paid for.

The table below shows an approximate cost analysis from the start of the project until the end of 2012. Please note that many of these costs are only estimates, based on experience at similar projects:-

Estimated costs Syra 3 JI Project:		
Secondary catalyst:	€	160,000
AMS and installation:	€	150,000
QAL2 audit	€	20,000
QAL3	€	45,000
AST x 2	€	20,000
Determination:	€	20,000
Verifications:	€	80,000
Approx total until 2012:	**€**	**495,000**

Table 5: Estimated JI project costs

Only the revenues from ERU sales would therefore be sufficient to pay back the investment costs of the project activity. The registration of the project activity as a JI Project is therefore the decisive factor for the realisation of the proposed project activity.

For all these reasons, the only alternative that does not face significant investment barriers is 1.1, the “continuation of the status quo”.

Technological barriers

Yara personnel do have experience of working with this catalyst due to the industrial trials that have taken place at Köping S3.

However, any of the available N_2O abatement technologies would have to be integrated into the nitric acid plant. Primary abatement technologies would be installed inside the ammonia oxidation reactor where they may, if not correctly designed and installed, interfere with the nitric acid production process by causing a deterioration of product quality or a loss of production output. Tertiary measures require the installation of a complete reactor between the absorption column and the stack, as well as a re-heating system, which may cause significant downtime of the plant during construction and commissioning.

Since industrial trials were carried out at the plant, it is clear that the installation of a certain quantity of secondary catalyst does not face insurmountable technical barriers. However, filling the basket with a full batch of catalyst does present certain technical risks and this can be demonstrated by the fact that the YARA management decided not to fill the catalyst containment system to its maximum capacity during the research and testing phase. The greater the bed depth of catalyst installed inside the burner, the more likely it will be that the plant encounters some problems associated with pressure drop. Additionally, the heavier the weight of catalyst, the stronger must be its supporting containment structure to accommodate the increased load.

It is therefore unlikely that any plant operator would be willing to confront these possible technical risks and install as much catalyst as possible on a purely voluntary basis without the incentive of any regulatory requirements (emissions caps) or financial benefits (such as revenues from the sale of ERUs).

Barriers due to prevailing practice

This test reconfirms the previous assessments: If the steps taken so far have led to the conclusion that one or more baseline scenario alternatives meet investment related or technological barriers, these scenarios should be excluded. Of course, similar plants that gain ERU or CER revenues by participating in the JI or CDM, and can thus overcome the identified barriers by using the additional financial means available, are not to be taken into account.

So far, secondary catalyst technology has only been operated in some European countries on an industrial trial basis. Researching this technology made sense due to the prospective revenues obtainable under the Kyoto Protocol’s Clean Development Mechanism (CDM), by employing it in nitric acid plants located in developing nations on a voluntary basis. Also, it is expected that N_2O emissions from nitric acid production may be included in the European Union Emissions Trading Scheme (“EU ETS”)[28] from 2013 onwards or regulated otherwise. Both aspects provided some incentive for developing N_2O abatement technology.

However, now that the research and development phase has been completed and secondary catalyst technology is being employed successfully in many CDM projects worldwide, plant operators would no longer be willing to incur the costs associated with the continued operation of such technology. For European nitric acid producers, the only incentive to operate such technology before the likely inclusion of N_2O emissions into the EU ETS from 2013 onwards is to take advantage of the incentives available under the Kyoto Protocol’s Joint Implementation (“JI”) mechanism. While this option has in principle been available since the beginning of 2008, EU member states took some time developing a coherent policy approach on whether or not to allow JI participation in their respective territories, and if so, under which conditions. This process has not been fully completed yet.

Such JI projects are currently being developed across the EU, e.g. Poland, Lithuania, Hungary, Romania, Bulgaria, France, Finland and Germany.

All scenarios, with the exception of the continuation of the "Status Quo", face significant investment barriers, as well as some technological barriers, and therefore have to be excluded from further analysis.

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):

The only scenario that does not face any technical, investment or common practice barriers and that is in compliance with all applicable regulations is the continuation of the present situation, the 'Status Quo': the operation of the plant without any abatement technology, following removal of the trial batch of catalyst at the end of the industrial trials in November 2009.

Step 4: Identify the most economically attractive baseline scenario alternative

The most economically attractive baseline scenario alternative is the continuation of the present situation: the operation of the plant without any abatement technology installed.

Sub-step 4a: Determine appropriate analysis method:

Since the implementation of the proposed project activity will generate no financial or economic benefits other than JI-related income, a simple cost analysis (Option 1) shall be applied.

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[28] On 23rd January 2008, the EU Commission published a communication on its post-2013 climate change strategy (see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0035:FIN:EN:PDF), which announces the determination to expand the EU ETS beyond its present scope, especially mentioning the inclusion of non-CO_2 gasses into the system. This development is no news to the industry, because responding to Article 30 of the EU ETS Directive 2003/87/EC, the Commission had submitted a report to the European Parliament and the Council considering the inclusion of non-CO_2 GHGs into the EU ETS already in November 2006. See the EU homepage under http://ec.europa.eu/environment/climat/emission/pdf/com2006_676final_en.pdf for this report which expressly considers extending the EU ETS into N_2O emissions (see page 6 therein).

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

As described in Sub-step 3a above, any operator willing to install and thereafter operate N_2O abatement technology under the JI faces significant investment and additional operating costs:

The plant must make significant initial investments for installation of the expensive secondary catalyst material and a sophisticated Automated Monitoring System (AMS). In addition, required training for AMS operation has to be undertaken by the responsible staff, and AMS calibration and other JI Project-related audits have to be arranged, facilitated and paid for.

Only the revenues from ERU sales would therefore be sufficient to pay back the investment costs of the project activity.

Step 5: Re-assessment of Baseline Scenario in course of proposed project activity's lifetime

If new or modified NOx or N2O emissions are introduced after the project start, a re-assessment of the baseline scenario should be carried out as follows:

Sub Step 5a: New or modified NO_X-emission regulations

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

- Selective Catalytic Reduction (SCR);
- Non-Selective Catalytic Reduction (NSCR);
- Tertiary measures incorporating a selective catalyst for destroying N_2O and NO_X emissions;
- Continuation of baseline scenario.

For the determination of the adjusted baseline scenario, the baseline scenario should be re-assessed and the baseline determination process should be applied as stipulated above (Steps 1 – 5).

Sub Step 5b: New or modified N_2O regulation

If legal regulations on N_2O emissions are introduced or changed during the crediting period, the baseline emissions shall be adjusted at the time the legislation is to be legally implemented.

N.B: Version 04 of the *Guidelines for Users of the Joint Implementation Project Design Document Form* (section B.1, Step 2) suggests that a table should be included at this point providing key information and data parameters used in establishing the baseline. However, since all of this information is already included in the tables in section D.1.1.3 and Annex 2 of this PDD, it is considered unnecessary in this case to include an additional table displaying identical information. Please therefore see sections D.1.1.3 and Annex 2 for information concerning data and parameters used for establishing the baseline.

B.2. Description of how the anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the JI project:

In this step, the JI project's additionality is ascertained. Project proponents need to demonstrate that the intended JI activity could only be realised if ERU sales revenues were available to offset the investments to be made. Because the project has no revenues other than JI-related revenues, a simple cost analysis is sufficient for demonstrating the project's additionality[29].

The proposed project activity aims to install secondary catalyst technology at the plant and to operate this catalyst throughout the crediting period. In order to assess the project emissions, an Automated Monitoring System (AMS) has to be installed and operated. In addition to the initial investment for the catalyst, YARA Köping S3 employees and management will have a significant additional work load to cope with in order to initiate the project activity and maintain it for the project's lifetime. The required training for catalyst and AMS operation has to be undertaken by the responsible staff, and the regular AMS calibration and other JI-related audits have to be arranged, facilitated and paid for.

As previously assessed, YARA Köping S3 has no need to invest in any N_2O destruction or abatement technology at present and so the identified baseline scenario alternative (the operation of the nitric acid plant without an N_2O abatement catalyst) would not incur any additional costs.

Revenues from the sale of ERUs are the only source of income that would be generated by the project activity.

In consequence, no income other than ERU sales revenues could be used to pay back the investment costs. The registration of the project activity as a JI Project and the resulting expected ERU revenues are the single source of project revenues. JI registration is therefore the decisive factor for the realisation of the proposed project activity.

The proposed JI project activity is undoubtedly additional, since it passes all the steps of the Additionality assessment, as defined by section B.2 above.

The identification of the baseline scenario and assessment of additionality should be re-conducted following any changes in legislation that may affect the JI project activity.

Conclusion

Köping S3 currently has no need to make any investment to decrease its N_2O emissions. Without the revenues from the sale of the ERUs generated by the project activity there would be no incentive to justify the additional cost and possible technical risks[30] associated with the implementation of the project activity. The project activity would not take place without the revenues from the sale of ERUs and therefore JI Project registration is the decisive factor for the realisation of the proposed project activity.

B.3. Description of how the definition of the project boundary is applied to the project:

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[29] See the "Tool for the demonstration and assessment of additionality" (Version 05.2); CDM EB 39th Meeting Report, Annex 10; published under http://cdm.unfccc.int/EB/039/eb39_repan10.pdf.

[30] See 'technological barriers' under Step 3, section B.1 for details of the technical risks associated with installing a full batch of secondary catalyst

The project boundary entails all parts of the nitric acid plant in so far as they are needed for the nitric acid production process itself. With regard to the process sequence, the project boundary begins at the ammonia burner inlets and ends at the tail gas stack. If and when installed, any form of NO_X-abatement device, such as the SCR unit, shall also be regarded as being within the project boundary, since this does not reduce N_2O emission levels.

The flow chart below provides an overview of the plant's process design:

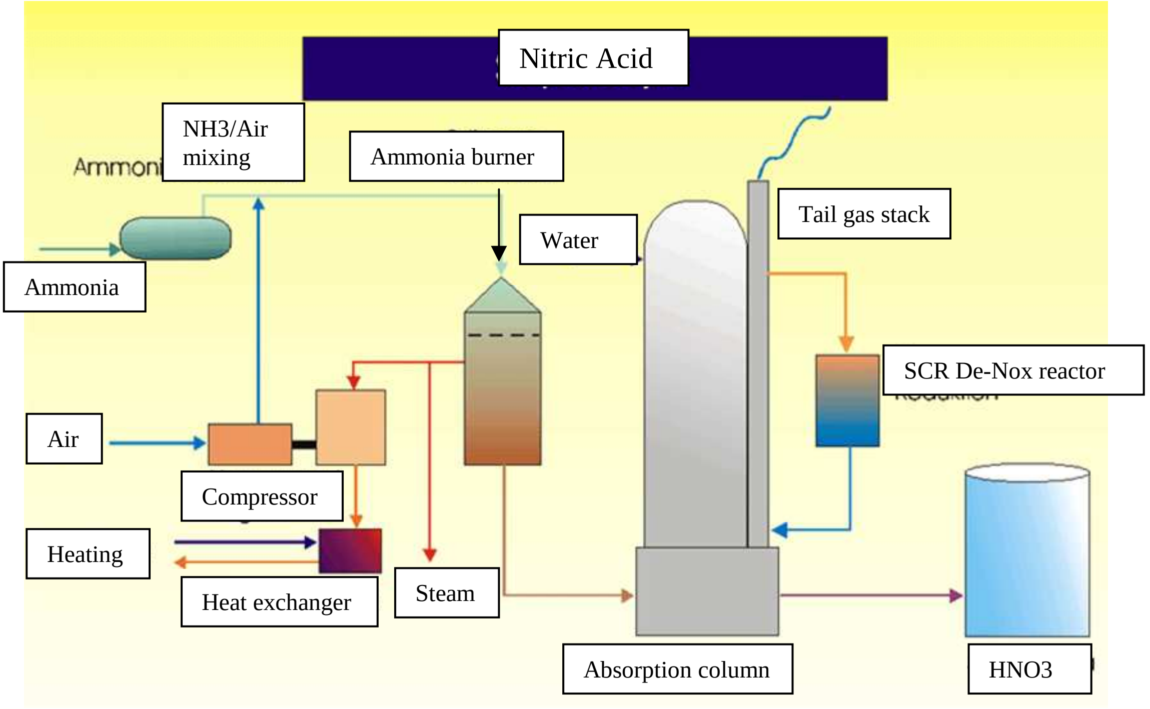

Illustration: Flow chart for the YARA Köping S3 nitric acid plant.

An overview of all emission sources within the project boundary is provided below:

	Source	Gas	Included?	Justification / Explanation
Baseline	Nitric Acid Plant (Burner Inlet to Stack)	CO_2	No	The process does not lead to any CO_2 or CH_4 emissions
		CH_4	No	
		N_2O	Yes	
Project Activity	Nitric Acid Plant (Burner Inlet to Stack)	CO_2	No	The process does not lead to any CO_2 or CH_4 emissions
		CH_4	No	
		N_2O	Yes	
	Leakage emissions	CO_2	No	No leakage emissions are expected.
		CH_4	No	
		N_2O	No	

Table 4: Overview of all emission sources within the project boundary

B.4. Further baseline information, including the date of baseline setting and the name(s) of the person(s)/entity(ies) setting the baseline:

Date of baseline setting: 19/11/2009

However, at the time of writing this PDD the baseline finishing date cannot yet be defined. The baseline is set by Mrs Rebecca Cardani-Strange and Mr Martin Stilkenbaeumer of N.serve Environmental Services GmbH. N.serve is a Project Participant listed in Annex 1.

In the absence of the final baseline emissions factor, a 'preliminary baseline emissions factor' of 7.99kgN_2O/tHNO_3 has been used for estimating in this PDD the expected emission reductions that will result from the project activity. This factor of 7.99kgN_2O/tHNO_3 is based on spot measurements taken throughout three full campaigns from June 2005 to April 2007, as explained in section A.4.3.1 above. N_2O data was obtained using a Rosemount Gaslog 800 analyser.

The final request for issuance of ERUs will not be based on the preliminary estimations in this PDD, but using the factual historic baseline emissions factor (EF_{BL}), which will be determined following the measurement of an historic baseline in the absence of the N_2O destruction technology.

The preliminary baseline emissions factor was calculated by Mrs Rebecca Cardani-Strange of N.serve Environmental Services GmbH on the 9th December 2009.

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

Starting date of the project: 12/10/2009 (submission of Project Idea Note to Finnish DFP)

The N_2O abatement catalyst can only be installed during a routine shutdown. At YARA Köping S3's plant a shutdown only takes place approximately every 6 to 8 months in order to exchange the primary catalyst gauzes. A shutdown took place in mid-November and the plant re-started production on 19th November 2009, which is intended as the start of the baseline campaign. The following shutdown and gauze change is scheduled to take place at the beginning of May 2010, when the plant will re-start production with a new set of gauzes and with the abatement catalyst installed (the exact date is yet to be confirmed).

C.2. Expected operational lifetime of the project:

Since the expected lifetime of the catalyst is three years, the anticipated duration of the project's operational life is also three years. In reality, however, the project is expected to run for only 2 years and 8 months (until the end of December 2012), since it is expected that N_2O emissions from HNO_3 plants will be covered by the EU ETS from 2013 onwards and that the project will no longer be viable[31]. If this is not the case, and N_2O is not otherwise regulated in a way that prohibits the continuation of the project, the catalyst will continue to be replaced every 3 years for the total operational lifetime of the plant, which is approximately 20 years.

The S3 plant has an operational life of about another 20 years and is therefore expected to be fully operational for the whole 10-year crediting period and beyond.

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[31] See footnote 27

C.3. Length of the crediting period:

The starting date of the crediting period is expected to be 01/05/2010.

Since the project is expected to be eligible to earn ERUs only up to the end of 2012, the likely project crediting period is 2 years and 8 months.

If any relevant agreement under the UNFCCC or the EU ETS should allow the continuation of the project, the project participants will apply to extend the crediting period to 20 years.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

The emission reductions achieved by the project activity will be monitored using the approved monitoring methodology, AM0034 (ver 03.4), as prepared by N.serve Environmental Services GmbH, Germany. It is the appropriate monitoring methodology to be used in conjunction with the baseline methodology AM0034 ver 03.4, “Catalytic reduction of N_2O inside the ammonia burner of nitric acid plants”. Its applicability depends on the same prerequisites as the mentioned baseline methodology.

AM0034 ver 03.4 requires the use of the European Norm EN14181 (2004) *“Stationary source emissions - Quality assurance of automated measuring systems”*[32] as a guidance for installing and operating the Automated Monitoring System (AMS) in the nitric acid plants for the monitoring of N_2O emissions.

An Automated Measuring System (AMS) consisting of the following shall be used for monitoring:

- An automated gas analyser system that will continuously measure the concentration of N_2O in the tail gas of the nitric acid plant; and
- A gas volume flow meter that uses differential-pressure to continuously monitor the gas volume flow, temperature and pressure in the tail gas of the nitric acid plant.

  Sampling shall be carried out continuously using a multiple-point sampling tube that is optimised to the specific width and height of the tail gas duct and the expected gas velocities in the tail gas. Temperature and pressure in the tail gas will also be measured continuously and used to calculate the gas volume flow at standard conditions.

Description of the AMS installed at YARA Köping S3 nitric acid plant.

1. General Description of the AMS

From the shutdown and gauze change in mid-November 2009, YARA Köping S3 plant is equipped with an EN-14181 compliant state of the art AMS consisting of a Dr. Födisch MCA 04 Continuous Emissions Analyser, a sample probe, heated filter and heated sample-line connected directly to the analyzer, and a Dr. Födisch FMD 99 Stack Gas Flow meter. The new analyzer is connected to the plant’s existing data collection system (Emerson DeltaV).

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[32] This standard describes the quality assurance procedures needed to assure that an Automated Measuring System (AMS) installed to measure emissions to air is capable of meeting the uncertainty requirements on measured values given by legislation, e.g. EU Directives, or national legislation, and more generally by competent authorities.

Since this nitric acid plant has been in operation since 1982, YARA Köping's staff in general, and its instrument department in particular, is accustomed to operating technical equipment adhering to high quality standards.

At the time of writing this PDD, Mr Jon Sletten (Site Manager) and Mr Axel Pallin (Process Engineer) are responsible for the overall implementation of the project. Mr Axel Pallin, Mr Jozef Meglic and Mr Mikael Larsson are responsible for the quality assurance, operation and maintenance of the N_2O monitoring system installed at the plant. It is possible that the people responsible for these tasks may change throughout the course of the project crediting period. Operation, maintenance and calibration intervals are being carried out by staff from the instrument department according to the vendor's specifications and under the guidance of internationally relevant environmental standards, in particular EN 14181 (2004). Service will be performed by the supplier of the AMS. YARA has defined an AMS checking procedure schedule and will continue to plan ahead for the remaining years of the crediting period, strictly adhering to the relevant standards.

All monitoring procedures at YARA are also conducted and recorded in accordance with the procedures under ISO 9001 and ISO 14001, which is regularly audited by an independent auditing organisation accredited for ISO 9001 certification[33].

2. Sample points

The sample points were chosen in accordance with the AMS requirements, EN 14181 requirements and the plant design specifications to allow an optimum of data collecting quality. The location of the sample points for the N_2O measurement [NCSG] and tail gas flow measurements [VSG] was selected to provide ease of access in a location close to the analyser. The most suitable location at Köping S3 is downstream of the tail gas expander in an upwards-sloping diagonal straight section of the tail gas pipe.

This section of pipe is 10.9m in length. The VSG sampling point is positioned at 5.6m along this pipe, while the NCSG sampling point is located at 6.1m. The calibration ports are a little further downstream in the same section of the pipe, at 6.85m.

3. Analyser

The Dr. Födisch MCA 04 Continuous Emissions Analyser is capable of analysing N_2O concentration in gas mixtures. The analysis system MCA 04 is an extractive, continuous measuring system. It extracts a partial gas flow from the flue gas, which is led to the analyser through a heated line (all heated components of the measuring system are regulated at 185 °C). This state of the art gas sampling and conditioning system and the most advanced photometer technology ensure high reliability and long operating times with short maintenance intervals.

The MCA 04 is a single beam photometer. It is based on the absorption of infrared light. For the calculation of a component's concentration the measuring technology registers unattenuated and attenuated intensity in the range of absorption wave lengths. For measurement of N_2O, Gas filter correlation technique is used.

According to EN 14181 the Analyser is QAL1[34] tested for the measurement of all standard components that usually are measured in the waste gas of large combustion plants, waste incineration plants or mechanical biological waste treatment plants. The QAL1 tested components are: CO, NO, SO_2, HCl, NH_3, H_2O.

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[33] External auditor: DNV

The QAL1 test for N_2O is currently ongoing and is expected to be completed in the near future. A QAL2 audit was performed in January 2010 by an independent laboratory with EN ISO/IEC 17025 accreditation. The final report will be provided to the determining AIE as soon as it becomes available.

A hot extractive analyser was chosen in order to address a particular safety concern. Since the analyzer will be installed downstream of the SCR unit where ammonia is used for NO_x abatement purposes, there is a possibility of the formation of ammonium nitrate/nitrite. In case of a cold measurement system, as usually applied in other plants, it is possible that due to the low temperature in the gas cooler and the analyzer solid nitrate/nitrite deposits could block the sampling lines, harm the analyzer and, in the worst case, lead to explosions when mechanically removed during maintenance works. In case of the MCA 04 analyzer all parts of the system that come into contact with the waste gas are heated well above 180°C. Therefore no solid deposits of nitrate/nitrite are possible. At the moment no QAL1 tested NDIR-Analyzer for N_2O is available on the market that fulfils the requirements of hot measurements according to the YARA internal safety rules.

4. Sample Conditioning System

As the gas sample is extracted, particles are removed with a heated filter unit at the sampling point and the clean sampling gas is delivered through a heated sampling line directly to the analyser in its cabinet, via the sampling pump. The temperature of the sampling gas is always maintained at 185 °C. The minimum flow rate to the analyser is controlled and connected to a general alarm. The alarm is connected to the data acquisition system.

5. Flow Meter

The Dr. Födisch FMD99 measuring system allows continuous determination of the flow rate of stack gas. It is type tested to the guidelines of the German Federal Ministry for the Environment, Nature Conservation and Reactor Safety on suitability testing of measuring equipment for continuous measuring of emissions[35] and is therefore officially QAL1 approved.

The flow measuring device FMD 99 is a highly sensitive system for continuous, in-situ flow measurement of the exhaust gas. The differential pressure is continuously measured via the dynamic pressure probe of the FMD 99.

The signal resulting from the differential pressure is a degree of the velocity respective to the flow of the exhaust gas. The flow meter is combined with the internal measurement of the absolute stack gas pressure (PSG) and the stack gas temperature (TSG).

Linking this device with the Emerson DeltaV data acquisition system, the data flows can be converted from operating to standard conditions, taking into account the other flow parameters, such as temperature and pressure.

6. The data acquisition system

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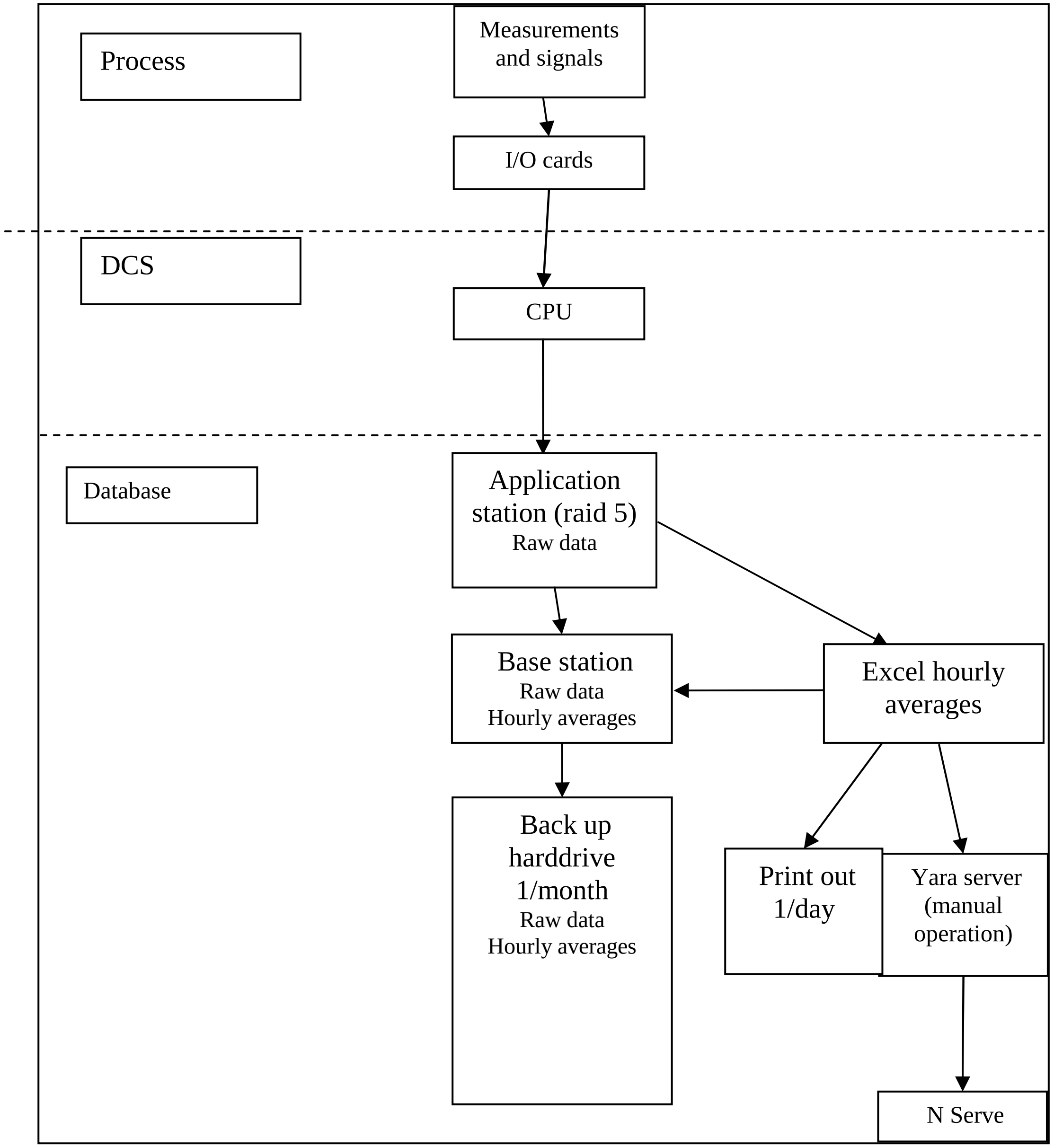
[34] TÜV Immissionsschutz und Energiesysteme GmbH, Köln TÜV Rheinland Group Report No. 936/21203173/A vom 13. Juli 2005

[35] TÜV Rheinland Sicherheit und Umweltschutz GmbH, Köln (report number 936/808 005/C vom 18. Februar 2000) and TÜV Immissionsschutz und Energiesysteme GmbH, Köln (report number 936/rö vom 15. Oktober 2003).

The YARA Köping S3 nitric acid plant is equipped with an Emerson DeltaV data collection and storage system that collects and stores the values for all the relevant monitoring parameters, as well as different status signals of the AMS and the NH_3 valve status signal from the nitric acid plant that defines whether or not the plant is in operation.

The data is stored simultaneously on 2 hard drives to prevent the loss of data in case one hard drive fails. Data that is directly related to plant operation, such as oxidation temperature, oxidation pressure, ammonia flow rate, ammonia to air ratio and nitric acid production rate, is also stored. The flow chart below shows this system in more detail:


Process
Measurements and signals
I/O cards
DCS
CPU
Database
Application station (raid 5) Raw data
Base station Raw data Hourly averages
Excel hourly averages
Back up harddrive 1/month Raw data Hourly averages
Print out 1/day
Yara server (manual operation)
N Serve

7. Data evaluation

The nitric acid plant operator derives hourly averages for all of the monitored parameters from the Emerson DeltaV data management system. This data is exported to EXCEL-format and delivered by email or CD from the plant operator to N.serve, who is responsible for the correct analysis of the delivered data in accordance with the PDD.

At N.serve the received data is stored on the N.serve fileserver in a special section for the storage of monitoring data separately for each project. The files are protected against manipulation by a password. Mr Martin Stilkenbäumer at N.serve is currently responsible for the correct data handling and processing, but this may change throughout the course of the project crediting period.

After a first plausibility-check, the data is transferred to a special database system. All necessary calculations and steps of data analysis of the monitoring data according to AM 0034 regulations, as well as other regulations outlined in this PDD, are carried out by N.serve using the database tool.

The results of the data analysis are transferred to an Excel spreadsheet. The results are used for definition of Project emissions as well as for the preparation of the Monitoring reports.

8. AMS QA procedures

The following section describes how the procedures given in EN14181 for QAL1, 2 and 3 have been adapted and are practically applied at the YARA nitric acid plant.

QAL 1

An AMS shall ideally 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 14956. 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.

A test institute shall perform all relevant tests on the AMS. The AMS has to be tested in the laboratory and field.

The chosen Dr. Födisch MCA 04 gas analyser is QAL1 [36] tested for the measurement of all standard components that usually are measured in the waste gas of large combustion plants, waste incineration plants or mechanical biological waste treatment plants. The QAL1 tested components are: CO, NO, SO2, HC1, NH3, H2O. The QAL1 test for N_2O is currently ongoing and is expected to be completed in the near future. A QAL2 audit will be performed by an independent laboratory with EN ISO/IEC 17025 accreditation.

A hot extractive analyser was chosen in order to address a particular safety concern. As described above, this is a YARA internal safety precaution.

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[36] TÜV Immissionsschutz und Energiesysteme GmbH, Köln TÜV Rheinland Group Report No. 936/21203173/A from 13. July 2005

The chosen Dr. Födisch FMD 99 stack gas flow meter has fulfilled the requirements of the QAL1 and was successfully tested by TÜV Rheinland Sicherheit und Umweltschutz GmbH, Köln, Germany[37].

QAL2

QAL2 is a procedure for the determination of the calibration function and its variability, and a test of the variability of the measured values of the AMS compared with the uncertainty given by legislation. The QAL2 tests are performed on suitable AMS that have been correctly installed and commissioned on-site (as opposed to QAL 1 which is conducted off-site). QAL2 tests are to be performed at least every 3 years according to EN 14181 (or following any major change to the monitoring system).

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 against the required uncertainty. There is a problem in fully complying with EN14181 since there is no regulation on N_2O emissions level and measurement uncertainty limit. According to EN14181, the QAL2 test including the SRM needs to be conducted by an independent "testing house" or laboratory which has to be accredited to EN ISO/IEC 17025. The QAL2 test was conducted in January 2010. The final report will be provided to the determining AIE as soon as it becomes available.

AST

In addition, Annual Surveillance Tests (AST) should be conducted in accordance with EN 14181; these are a series of measurements that need to be conducted with independent measurement equipment in parallel to the existing AMS. The AST tests are performed annually. If a full QAL 2 test is performed (at least every 3 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 for uncertainty.

This is achieved by conducting periodic zero and span checks on the AMS. Zero and span adjustments or maintenance of the AMS may be necessary depending on the results of the evaluation. The results of the checks will be recorded in control charts (for example Shewhart/CUSUM etc), which will be used to evaluate the zero and span drift. In essence, YARA staff performs QAL3 procedures through the established calibration procedures described below.

AMS calibration and QA/QC procedures

The monitoring equipment used to derive the N_2O emissions data for this project will be made part of the ISO 9001 procedures.

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[37] TÜV Rheinland Sicherheit und Umweltschutz GmbH, Köln (report number 936/808 005/C vom 18. Februar 2000) and TÜV Immissionsschutz und Energiesysteme GmbH, Köln (report number 936/rö from 15. October 2003

N_2O-Analyser Zero Adjustments/Calibration

Conditioned ambient air is used as reference gas for the zero check. The zero adjustment is conducted automatically every 24 hours. Manual adjustments are done at least once every four weeks (the calibration frequency might be adjusted if necessary).

N_2O-Analyser Span Adjustements/Calibration

Manual span checks are done with certified calibration gas at least once every four weeks (the calibration frequency might be adjusted if necessary).

The results and subsequent actions are all documented as part of the QAL3 documentation. In addition, the analyser room and equipment is visually inspected at least once a week and the results are documented in analyser specific log-books.

Flow meter calibration procedures

The flow meter FMD 99 itself does not need to be calibrated since it is a physical device which will not have drift. Therefore, it is sufficient to regularly inspect the physical condition of the Dr. Födisch FMD. It is checked regularly for the following: Visual check; electric check; cleaning of probe, if necessary. In addition the flow meter is checked during the QAL2 and AST tests by an independent laboratory by comparison to a standard reference method (SRM).

D.1.1. Option 1 – Monitoring of the emissions in the project scenario and the baseline scenario:

D.1.1.1. Data to be collected in order to monitor emissions from the project, and how these data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	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
P.1	*$NCSG_n$* *Average N_2O concentration in the tail gas during the project campaign n.*	*N_2O analyser (part of AMS)*	*mgN_2O/Nm^3 (converted from ppm if necessary)*	*Measured*	*Hourly average value based on a recording frequency of 2 seconds.*	*100%*	*Electronic*	*The data output from the analyser will be processed using appropriate software. The information will be stored for the duration of the*

								project, plus two years thereafter.
P.2	VSG_n *Average Volume flow rate of the tail gas during the project campaign n.*	*Gas volume flow meter (part of AMS)*	Nm^3/h	*Measured*	*Hourly average value based on a recording frequency of 2 seconds.*	*100%*	*Electronic*	*The data output from the tail gas flow meter will be processed using appropriate software and corrected for standard conditions (273.15 °K, 1013.25 hPa) using TSG (P.7) and PSG (P.8) data.* *The information will be stored for the duration of the project, plus two years thereafter*
P.3	OH_n *Total operating hours during the project campaign n*	*Production Log, plant status signal*	*Hours*	*Measured*	*Daily, compiled for entire campaign*	*100%*	*Electronic*	*Electronically recorded, based on plant status signals*
P.4	NAP_n *Metric tonnes of 100% concentrated*	*Nitric acid flow meter*	$tHNO_3$	*Measured and calculated at 100% concentration*	*Hourly average value based on a recording frequency of 30 seconds.*	*100%*	*Electronic*	*Measurements will be cross-checked against a Mass Balance Calculation (see*

	nitric acid during the project campaign n							*section D.1.1.2 for details). The Mass Balance calculation will also act as a back-up in case of flow meter malfunction.*
P.5	PE_n *N$_2$O emissions during the project campaign n.*	*Calculation from measured data.*	tN_2O	*calculated*	*Calculated after each project campaign*	*100%*	*Electronic*	
P.6	EF_n *Emissions factor calculated for the project campaign n*	*Calculated from measured data*	$tN_2O / tHNO_3$	*Calculated*	*After each project campaign*	*100%*	*Electronic*	
P.7	*TSG* *Temperature of tail gas*	*Probe (part of the AMS gas volume flow meter).*	*°C*	*Monitored.*	*Hourly average value based on a recording frequency of 2 seconds.*	*100%*	*Electronic*	*Used for normalization of VSG measurement to standard conditions see P.2* *Also to be monitored throughout the baseline campaign.*
P.8	*PSG*	*Probe (part of*	*Pa*	*Monitored.*	*Hourly average*	*100%*	*Electronic*	*Used for*

	Pressure of tail gas	*the AMS gas volume flow meter).*			*value based on a recording frequency of 2 seconds.*			*normalization of VSG measurement to standard conditions see P.2* *Also to be monitored throughout the baseline campaign.*
P.9	*AIFR* *Ammonia to air ratio to the ammonia oxidation reactor (AOR)*	*Ammonia & Air flow meters*	*%*	*Monitored & Calculated*	*Hourly value*	*100%*	*Electronic*	*Data of AIFR will be used to determine if the plant was operating outside the trip point ranges during the project campaigns.* *AIFR is also to be monitored throughout the baseline campaign to determine if the plant was operating outside of* $AIFR_{max}$*.*

P.10	*OT_h* *Oxidation temperature in the ammonia oxidation reactor (AOR) for each hour of the production campaign*	*Thermocouple with tag number '48TICA-807' inside the AOR*	*°C*	*Measured*	*Hourly value*	*100%*	*Electronic*	*Data of OT will be used to determine if the plant was operating outside the trip point ranges during the project campaigns.* *OT is also to be monitored throughout the baseline campaign to determine if the plant was operating outside of OT_{normal}*
P.11	*$GS_{project}$* *Gauze supplier for project campaigns*	*Plant documentation*		*Recorded*	*For each project campaign*	*100%*	*Electronic or paper*	*To be obtained during the project campaigns.* *This information is used as a plausibility check against the information on Gauze Composition.*

P.12	$GC_{project}$ *Gauze composition during project campaigns*	*Plant documentation*	*% of various metals*	*Recorded*	*For each project campaign*	*100%*	*Electronic or paper*	*To be obtained during the project campaigns*
P.13	CL_n *Length of the project campaign in tonnes of nitric acid produced*	*Daily* HNO_3 *production data*	$tHNO_3$	*Calculated*	*At the end of the project campaign*	*100%*	*Electronic*	
P.14	EF_{reg} *Emissions cap for* N_2O *from nitric acid production set by government or local regulation*	*Swedish Environmental Law*	$kgN_2O/tHNO_3$ *(converted, if necessary)*	*Not applicable*	*Continuous.*	*100%*	*Paper*	*Continuous surveillance throughout crediting period* *Also to be taken into consideration throughout the baseline campaign*

D.1.1.2. Description of formulae used to estimate project emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

Since the factual project emissions factors have not yet been established, the following equations are used for estimating in this PDD the emissions expected during the project:

$$EF_{Pest} = EF_{BLPR} *(1- AE) \qquad (kgN_2O/tHNO_3) \qquad \textbf{(1)}$$

Where:

Variable	Definition
EF_{Pest} =	Estimated Project Emissions Factor ($kgN_2O/tHNO_3$)
EF_{BLPR} =	Preliminary Baseline Emissions Factor, calculated in accordance with section A.4.3.1 ($kgN_2O/tHNO_3$)
AE =	Predicted Abatement Efficiency of secondary catalyst (%)

$$PEn_{est} = EF_{Pest} * NAPn_{est} / 1000 \quad (tN_2O) \tag{2}$$

Where:

Variable	Definition
PEn_{est} =	Estimated Project Emissions during campaign n (tN_2O)
$NAPn_{est}$ =	Estimated HNO_3 production during campaign n ($tHNO_3$)

D.1.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions of greenhouse gases by sources within the project boundary, and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	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

B.1	*$NCSG_{BC}$* *Average N_2O concentration in the tail gas during the baseline campaign.*	*N_2O analyser (part of MCA 04 AMS)*	*mgN_2O/Nm^3 (converted from ppm if necessary)*	*Measured*	*Hourly average value based on a recording frequency of 2 seconds.*	*100%*	*Electronic*	*The data output from the analyser will be processed using appropriate software.* *The information will be stored for the duration of the crediting period*
B.2	*VSG_{BC}* *Average Volume flow rate of the tail gas during the baseline campaign.*	*Gas volume flow meter FMD 99*	*Nm^3/h*	*Measured*	*Hourly average value based on a recording frequency of 2 seconds.*	*100%*	*Electronic*	*The data output from the tail gas flow meter will be processed using appropriate software and corrected for standard conditions (273.15 °K, 1013.25 hPa) using TSG (P.7) and PSG (P.8) data.* *The information will be stored for the duration of the crediting period, plus 2 years thereafter*

B.3	OH_{BC} *Total operating hours during the baseline campaign*	*Production Log, plant status signal*	*Hours*	*Measured*	*Daily, compiled for entire campaign*	*100%*	*Electronic*	*Electronically recorded, based on plant status signal*
B.4	NAP_{BC} *Metric tonnes of 100% concentrated nitric acid during the baseline campaign*	*Plant data on NH3 consumption, weight of HNO3 exported and quantity of ammonium nitrate produced*	$tHNO_3$	*Calculated using mass balance calculation (MBC)*	*Daily, compiled for entire campaign*	*100%*	*Electronic*	*No accurate HNO3 flow meter yet installed.* *MBC will be cross-checked with tank level measurements and SAP billing information.*
B.5	BE_{BC} *Total N2O emissions during the baseline campaign*	*Calculated from measured data*	tN_2O	*Calculated*	*At the end of the baseline campaign*	*100%*	*Electronic*	
B.6	EF_{BL} *Emissions factor for the baseline campaign*	*Calculated from measured data*	$tN_2O/tHNO_3$	*Calculated*	*At the end of the baseline campaign*	*100%*	*Electronic*	
B.7	*AFR* *Ammonia Flow rate to the ammonia oxidation reactor (AOR)*	*Ammonia flow meter*	$kgNH_3/h$	*Measured*	*Hourly average value based on a recording frequency of 30 seconds.*	*100%*	*Electronic*	*Monitored data of AFR will be used to determine if plant was operating outside of* AFR_{max} *during the baseline*

								campaign.
B.8	*UNC* *Overall measurement uncertainty of the AMS*	*Calculation of combined uncertainty of AMS*	*%*	*Calculated*	*Once, following commissioning of AMS*	*100%*		
B.9	CL_{BL} *Length of the baseline campaign in tonnes of nitric acid produced*	*Daily* HNO_3 *production data*	$tHNO_3$	*Calculated*	*At the end of the baseline campaign*	*100%*	*Electronic*	
B.10	OP_h *Pressure in the ammonia oxidation reactor (AOR) for each hour of the production campaign*	*Pressure probe at the burner inlet*	*Pa*	*Measured*	*Hourly value.*	*100%*	*Electronic*	*Data of* OP_h *will be used to determine if the plant was operating outside of* OP_{normal} *during the baseline campaign*

B.11	GS_{BL} *Gauze supplier for the baseline campaign*	*Plant documentation*		*Recorded*	*For the baseline campaign*	*100%*	*Electronic or paper*	*To be obtained during the baseline campaign.* *This information is used as a plausibility check against the information on Gauze Composition.*
B.12	GC_{BL} *Gauze composition during baseline campaign*	*Plant documentation*	*% of various metals*	*Recorded*	*For the baseline campaign*	*100%*	*Electronic or paper*	*To be obtained during the baseline campaign*

D.1.1.4. Description of formulae used to estimate baseline emissions (for each gas, source etc.; emissions in units of CO_2 equivalent):

Since the factual baseline emissions have not yet been established, the following equations are used for estimating in this PDD the emissions expected during the baseline campaign:

$$BE_{BCest} = EF_{BLPR} * NAP_{BCest} / 1000 \qquad (tN_2O) \qquad \textbf{(3)}$$

Where:
Variable Definition
BE_{BCest} = Estimated Emissions during baseline campaign (tN_2O)
EF_{BLPR} = Preliminary Baseline Emissions Factor, calculated in accordance with section A.4.3.1 ($kgN_2O/tHNO_3$)
NAP_{BCest} = Estimated HNO_3 production during baseline campaign ($tHNO_3$)

D. 1.2. Option 2 – Direct monitoring of emission reductions from the project (values should be consistent with those in section E.):

Emissions reductions from the project will not be monitored, but calculated following measurement of the parameters listed in section D.1.1.1 and D.1.1.3 above.

D.1.2.2. Description of formulae used to calculate emission reductions from the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

Measuring of N_2O data sets for the calculation of project emissions

Throughout the project's crediting period, N_2O concentration ($NCSG_n$) and volume flow in the stack gas (VSG_n) are to be monitored. The monitoring system provides separate hourly average values for $NCSG_n$ and VSG_n based on 2-second interval readings. These N_2O data sets (consisting of $NCSG_n$ and VSG_n average values for each operating hour) can be identified by means of a unique time / date key indicating when exactly the values were observed.

Furthermore, the operating hours (OH_n) as recorded by the plant's process control system and the nitric acid production output (NAP_n) are required for calculating the project emissions.

Calculation of HNO3 production (NAP)

Baseline

Since an accurate and reliable HNO_3 flow meter has not yet been installed at the plant (the current flow meter often malfunctions), the nitric acid production is currently ascertained by means of a mass balance calculation, taking into account ammonia consumption, as follows:

$$\text{Production} = \frac{Q_{801} \times \rho_{NH3}}{K_2 \times 1000} \qquad \textbf{(4)}$$

Where:

Q_{801} = NH3 flow to the reactor in Nm_3/h (Flow meter F-801)

ρ_{NH3} = Ammonia density 0.771kg/Nm_3

K_2 = Constant of ammonia production (0.287kg NH_3/kg HNO_3

This result is then cross-checked against the quantity of HNO_3 exported off-site (SAP billing information), the quantity of ammonium nitrate produced from nitric acid on-site and the tank level measurements.

<u>Project</u>

A new and more accurate HNO_3 flow meter will be installed before the beginning of the first project campaign and will be used to measure NAP throughout the project activity. The resulting figures will be cross-checked against the mass balance calculation described above.

Furthermore, in order to ensure the reliability of the baseline NAP measurement results achieved with the Mass Balance Calculation, the results of these calculations shall be reassessed during the first verification, in comparison with the measurements recorded with the new HNO3 flow meter during the first project campaign.

Downtime of Automated Monitoring System

In case of malfunction of the AMS during the **baseline** campaign, either the conservative IPCC default factor of 4.5kg N_2O/tHNO_3 or the last valid measured value (whichever is the *lowest*) will be applied for calculating the baseline emissions factor. In the case of malfunction of the AMS during the **project** campaigns, the highest measured value in the campaign will be applied for calculating the campaign emissions factor.

Measurement during plant operation

Only those data sets collected during operation of the plant shall be used as a basis for determining the campaign-specific project emissions. Most plants have one or more trip point values, normally defined by the manufacturer and specified in the plant's operating manuals. At Köping S3, the plant's operational status can be determined by whether or not NH3 is still flowing into the AOR. When the ammonia valve status signal indicates that the plant's ammonia valve is closed, the plant is considered to be off-line. In addition, trip point values for oxidation temperature and ammonia to air flow ratio have been defined and these parameters will be used for the purposes of a plausibility check, since as soon as the NH_3 valve closes, both the NH_3/air ratio and oxidation temperature will be immediately affected and go outside the trip point ranges. The trip point range for the ammonia oxidation temperature is 830°C (min) to 925°C (max), while the maximum ammonia to air ratio is 11.5%.

In order to ensure the proper functioning of the NH_3 and air input transmitters, particularly following any major shutdown or trip of the plant, the performance of the transmitters and signals relating to NH_3 and air flows are checked by the operators following any shutdown of the plant that lasts longer than 6 hours.
In addition, the production figures are analysed on a daily basis by the responsible operator and any significant deviation in oxidation temperature is immediately investigated.

For the avoidance of doubt, data sets containing values during shut down of the plant are not to be regarded as AMS downtime readings (as defined above).

Application of instrument correction factors / elimination of implausible values

The correction factors derived from the calibration curve of the QAL2 audit for all components of the AMS, as determined during the QAL2-test in accordance with EN14181, must be applied onto both VSG and NCSG, unless these were already automatically applied to the raw data recorded by the data storage system at the plant.

For all N_2O data sets a plausibility check is conducted in accordance with current best practice monitoring standards. All data sets containing values that are implausible are eliminated.

Determination of the permitted operating conditions of the nitric acid plant to avoid overestimation of baseline emissions

In order to avoid the possibility that the operating conditions of the nitric acid production plant are modified in such a way that increases N_2O generation during the baseline campaign, the normal ranges for operating conditions shall be determined for the following parameters:

(i) oxidation temperature; (ii) oxidation pressure; (iii) ammonia gas flow rate, and (iv) air input flow rate

The permitted range shall be established using the procedures described below. Note that data for these parameters is now routinely logged in the process control systems of the plant.

(i) and (ii) Oxidation temperature and pressure:

Process parameters to be monitored are the following:

OT_h	Oxidation temperature for each hour (°C);
OP_h	Oxidation pressure for each hour (Pa);
OT_{normal}	Normal range for oxidation temperature (°C);
OP_{normal}	Normal range for oxidation pressure (Pa).

The permitted range for oxidation temperature and pressure is to be determined using historical data for the operating range of temperature and pressure from five previous campaigns.

However, the four previous campaigns at the S3 plant, which ran from April 2007 to November 2009, cannot be considered representative of standard plant operation, since a partial batch of secondary catalyst was installed for industrial testing purposes. In addition, data from the two campaigns prior to that (between 18.01.2006 and April 2007) is missing, since the data recording system crashed and all the data was irretrievably lost.

The project participants therefore have no choice but to use data from the five campaigns prior to 18.01.2006 in order to determine the historic operating ranges for OT and OP. These five campaigns cover the period from 05.11.2003 to 18.01.2006.

The permitted range is determined through a statistical analysis of the historical data in which the time series data is to be interpreted as a sample for a stochastic variable. All data that falls within the upper and lower 2.5% percentiles of the sample distribution is defined as abnormal and shall be eliminated. The permitted range of operating temperature and pressure is then assigned as the historical minimum (value of parameter below which 2.5% of the observation lies) and maximum operating conditions (value of parameter exceeded by 2.5% of observations).

(iii) and (iv) Ammonia gas flow rates and ammonia to air ratio input into the ammonia oxidation reactor (AOR):

Parameters to be monitored:

AFR	Ammonia gas flow rate to the AOR (tNH_3/h);
AFR_{max}	Maximum ammonia gas flow rate to the AOR (tNH_3/h);
AIFR_	Ammonia to air ratio (%);
$AIFR_{max}$_	Maximum ammonia to air ratio (%).

The upper limits for ammonia flow and ammonia to air ratio shall be determined using historical maximum operating data for ammonia gas and ammonia to air ratio for five previous campaigns.

However, as described above, the four previous campaigns at the S3 plant (which ran from April 2007 to November 2009) cannot be considered representative of standard plant operation, since a partial batch of secondary catalyst was installed for industrial testing purposes. In addition, data from the two campaigns prior to that (between 18.01.2006 and April 2007) is missing, since the data recording system crashed and all the data was irretrievably lost.

The project participants therefore have no choice but to use data from the five campaigns prior to 18.01.2006 in order to determine the historic maximum operating values for AFR and AIFR. These five campaigns cover the period from 05.11.2003 to 18.01.2006.

Once the permitted ranges for pressure, temperature, ammonia flow rate and ammonia to air ratio are determined, it must also be demonstrated that these ranges are within the specifications of the facility. If not, the baseline campaign must be reassessed.

Calibrations for the operating parameters OT, OP, AFR and AIFR (including primary air flow) will be carried out in accordance with Yara internal quality control procedures.

Composition of the ammonia oxidation catalyst

In accordance with methodology AM0034 ver 03.4, "If the composition of the ammonia oxidation catalyst used for the baseline campaign and after the implementation of the project are identical to that used in the campaign for setting the operating conditions (previous five campaigns), then there shall be no limitations on N_2O baseline emissions".

In the case of Köping S3, the previous four campaigns cannot be considered representative of normal plant operation, since a partial batch of secondary catalyst was installed for industrial testing purposes. Additionally, in order to remain consistent, the same production campaigns should be used for assessment of gauze composition as are used for establishment of the historical operating ranges, as specified above (05.11.2003 to 18.01.2006).

In the case of S3, the gauze composition used during campaign number three (8.10.2004 to 26.01.2005) cannot be considered representative of standard gauze composition and must be excluded from the analysis; An emergency replacement gauze pack was used in response to an unexpected stoppage at the end of campaign two, due to mechanical problems with the burner basket. The remaining four campaigns with standard gauze packs will therefore be used for the determination of GCnormal.

The same gauze supplier and composition is being used for the baseline campaign and shall continue to be used for the duration of the project.
The composition of the gauzes at Syra 3 is highly confidential and this information will only be made available to the determining and verifying AIEs.

Parameters to be monitored for composition of the catalyst are as follows:

GS_{normal}	Gauze supplier for the operation condition campaigns;
GS_{BL}	Gauze supplier for baseline campaign;
$GS_{project}$	Gauze supplier for the project campaigns;
G_{normal}	Gauze composition for the operation condition campaigns;
GC_{BL}	Gauze composition for baseline campaign;
$GC_{project}$	Gauze composition for the project campaigns

Campaign Length

In order to take into account the variations in campaign length and its influence on N_2O emission levels, the historic campaign lengths and the baseline campaign length are to be determined and compared to the project campaign length. Campaign length is defined as the total number of metric tonnes of nitric acid at 100% concentration produced with one set of gauzes

Historic Campaign Length (CL_{normal})

The average historic campaign length (CL_{normal}) is defined as the average campaign length for the five historic campaigns used to define the operating conditions (the five campaigns between 05.11.2003 and 18.01.2006), excluding abnormal campaigns. This will then be used as a cap on the length of the baseline campaign. See annex 2 for more details on CLnormal.

Baseline Campaign Length (CL_{BL})

If $CL_{BL} \leq CL_{normal}$, all N_2O values measured during the baseline campaign can be used for the calculation of EF_{BL} (subject to the elimination of data that was monitored during times where the plant was operating outside of the 'permitted range').
If $CL_{BL} > CL_{normal}$, N_2O values that were measured beyond the length of CL_{normal}, during the production of the quantity of nitric acid (i.e. the final tonnes produced) are to be eliminated from the calculation of EF_{BL}.

Project Campaign Length

(a) Longer Project Campaign
If the length of each individual project campaign CL_n is longer than or equal to the average historic campaign length CL_{normal}, then all N_2O values measured during the project campaign can be used for the calculation of EF (subject to the elimination of data from the ammonia/air analysis, see above);

(b) Shorter Project Campaign
If $CL_n < CL_{normal}$, recalculate EF_{BL} by eliminating those N_2O values that were obtained during the production of tonnes of nitric acid beyond the CL_n (i.e. the last tonnes produced).

Determination of baseline emission factor: measurement procedure for N_2O concentration and gas volume flow

N_2O concentration and gas volume flow are to be monitored throughout the baseline campaign. The EN14181-compliant monitoring system will provide separate readings for N_2O concentration and gas flow volume for a defined period of time (an hourly average will be calculated from the values recorded every 2 seconds). Error readings (e.g., downtime or malfunction) and extreme values are to be automatically eliminated from the output data series by the monitoring system.

Measurement results can be distorted before and after periods of downtime or malfunction of the monitoring system and can lead to mavericks. To eliminate such extremes and to ensure a conservative approach, the following statistical evaluation is to be applied to the complete data series of N_2O concentration, as well as to the data series for gas volume flow. The statistical procedure will be applied to data obtained after eliminating data measured for periods where the plant was operating outside the permitted ranges:

(a) Calculate the sample mean (x);
(b) Calculate the sample standard deviation(s);
(c) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation);

(d) Eliminate all data that lie outside the 95% confidence interval;
(e) Calculate the new sample mean from the remaining values (volume of stack gas (VSG) and N_2O concentration of stack gas (NCSG).

The average mass of N_2O emissions per hour is estimated as a product of the NCSG and VSG. The N_2O emissions per campaign are estimated as a product of N_2O emissions per hour and the total number of complete operating hours of the campaign using the following equation:

$$BE_{BC} = VSG_{BC} * NCSG_{BC} * OH_{BC} * 10^{-9} \qquad (tN_2O) \qquad \textbf{(5)}$$

The plant-specific baseline emissions factor representing the average N_2O emissions per tonne of nitric acid over one full campaign is derived by dividing the total mass of N_2O emissions by the total output of 100% concentrated nitric acid for that period.

The overall uncertainty of the monitoring system shall also be determined during the QAL2 audit and the measurement error will be expressed as a percentage (*UNC*). The N_2O emission factor per tonne of nitric acid produced in the baseline period (EF_{BL}) shall then be reduced by the estimated percentage error as follows:

$$EF_{BL} = \left(1 - \frac{UNC}{100}\right)\left(\frac{BE_{BC}}{NAP_{BC}}\right) \qquad (tN_2O/tHNO_3) \qquad \textbf{(6)}$$

Where:

EF_{BL} = Baseline N_2O emissions factor ($tN_2O/tHNO_3$)
BE_{BC} = Total N_2O emissions during the baseline campaign (tN_2O)
$NCSG_{BC}$ = Mean concentration of N_2O in the stack gas during the baseline campaign (mgN_2O/m^3)
OH_{BC} = Total operating hours of the baseline campaign (h)
VSG_{BC} = Mean gas volume flow rate at the stack in the baseline measurement period (m^3/h)[38]

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[38] VSG_{BC} and $NCSG_{BC}$ should be measured simultaneously and values should be expressed on the same basis (wet or dry) and should be corrected to normal conditions (101.325 kPa, 0 deg C). If the instrument (or measurement system) uses an algorithm to convert actual conditions to normal conditions, the proper source of such an algorithm should be used (e.g., based on procedures of EN14181). In all cases, either manual or algorithm-based conversion of actual conditions to normal conditions, the temperature and pressure of actual conditions of stack gas should be recorded as per the monitoring plan of this methodology.

NAP_{BC} = Total nitric acid production during the baseline campaign ($tHNO_3$)
UNC = Overall uncertainty of the monitoring system (%), calculated as the combined uncertainty of the applied monitoring equipment

In the absence of any national or regional regulations governing N_2O emissions, the resulting EF_{BL} will be used as the baseline emission factor.

The baseline campaign is not valid and must be repeated if the plant operates outside the permitted range of operating conditions (see '*Determination of the permitted operating conditions...'* above for more details*)* for more than 50% of the duration of the baseline campaign. In order to further ensure that operating conditions during the baseline campaign are representative of normal operating conditions, statistical tests should be performed to compare the average values of the permitted operating conditions with the average values obtained during the baseline determination period. If it can be concluded with 95% confidence level, in any of the tests, that the two values are different, then the baseline determination should be repeated.

Calculation of the Project Emissions

The same statistical data evaluation that was described above for the calculation of baseline emissions is also to be applied to the project data series.

Estimation of campaign-specific project emissions

The total mass of N_2O emissions in a Campaign (PE_n) is the product of the remaining valid $NCSG_n$ and VSG_n-values multiplied by OH_n.

The following equation is used:

$$PE_n = VSG_n * NCSG_n * 10^{-9} * OH_n \qquad (tN_2O) \qquad \mathbf{(7)}$$

The plant-specific project emissions factor, representing the average N_2O emissions per tonne of nitric acid over the respective campaign, is derived by dividing the total mass of N_2O emissions by the total output of 100% concentrated nitric acid for that period.

The average N_2O emissions per metric ton of 100% concentrated nitric acid for the campaign (EF_n) shall then be calculated as follows:

$$EF_n = (PE_n / NAP_n) \qquad (tN_2O/tHNO_3) \qquad \mathbf{(8)}$$

where:

Variable	Definition
PE_n	total specific N_2O emissions during the campaign (kgN_2O)
EF_n	Emissions factor used to calculate the emissions from the campaign n ($kgN_2O/tHNO_3$)
$NCSG_n$	Mean concentration of N_2O in the tail gas stream during the campaign (mgN_2O/m^3)
OH_n	Operating hours of the plant during the campaign (h)
VSG_n	Mean tail gas volume flow rate during the campaign (m^3/h)
NAP_n	Nitric acid production during the campaign ($tHNO_3$)

Derivation of a moving average emission factor

A moving average emission factor shall be calculated in accordance with AM0034 ver 03.4. However, since the objective of the moving average emissions factor is to account for possible long term emissions trends (and not to penalise the project participants for any temporary period of technical difficulty), any periods during which the catalyst was experiencing technical problems should be excluded from the calculation of the moving average emissions factor, since these periods would not be representative of standard plant operation.

The moving average emission factor is to be calculated as follows:

$$EF\ ma, n = (EF_1 + EF_2 + \ldots + EFn)/n \quad (tN_2O/tHNO_3) \qquad \textbf{(9)}$$

This process is repeated for each campaign such that a moving average $EF_{ma,n}$ is established over time, becoming more representative and precise with each additional campaign.

To calculate the total emission reductions achieved in a campaign, the higher of the two values $EF_{ma,n}$ and EF_n shall be applied as the emission factor relevant for the particular campaign to be used to calculate emissions reduction s (EF_p). Thus:

If $EF_{ma,n} \geq EF_{n,}$, , then $EF_p = EF_{ma,n}$ **(10)**

If $EF_{ma,n} < EF_{n,}$,then $EF_{p\,n} = EF_n$

Where:

Variable		Definition
EF_n	=	Emissions factor calculated for a specific project campaign (tN2O/tHNO3)
$EF_{ma,n}$	=	Moving average (ma) emissions factor after nth campaigns, including the current campaign (tN2O/tHNO3)
n	=	Number of campaigns to date
EF_p	=	Emissions factor that will be applied to calculate the emissions reductions from this specific campaign (i.e. the higher of EFx and EFn) (tN2O/tHNO3)

Minimum project emission factor

A campaign-specific emissions factor shall be used to cap any potential long-term trend towards decreasing N_2O emissions that may result from a potential build up of platinum deposits. After the first ten campaigns of the crediting period of the project, the lowest EF_n observed during those campaigns will be adopted as a minimum (EF_{min}). If any of the later project campaigns results in an EF_n that is lower than EF_{min}, the calculation of the emission reductions for that particular campaign shall use EF_{min} and not EF_n.

Leakage

No leakage calculation is required.

Calculation of emission reductions

The **emissions reductions for which ERUs will be issued** for the project activity are determined by deducting the project-specific emission factor from the baseline emissions factor and multiplying the result by the production output of 100% concentrated nitric acid over the campaign and the GWP of N_2O, as follows:

$$ERU = (EF_{BL} - EF_p) \text{ x } NAP \text{ x } GWP_{N2O} \quad (tCO_2e) \qquad \textbf{(11)}$$

Where:

Variable	Definition
ERU =	Emission reductions awardable to the project for the specific campaign (tCO_2e)
NAP =	Nitric acid production during the project campaign ($tHNO_3$). The maximum value of NAP shall not exceed the design capacity[39].
EF_{BL} =	Baseline Emissions factor ($kgN_2O/tHNO_3$);
EF_p =	Emissions factor used to calculate the emissions from the particular campaign (i.e., the higher of $EF_{ma,n}$ and EF_n ($kgN_2O/tHNO_3$).
GWP_{N2O} =	Global warming potential of N_2O as per IPCC default value (310) (tCO_2e/tN_2O)

Impact of regulations

Should N_2O emissions regulations that apply to nitric acid plants be introduced in the host country or jurisdiction covering the location of the project activity, such regulations shall be compared to the calculated baseline emissions factor for the project (EF_{BL}), regardless of whether the regulatory level is expressed as:

- An absolute cap on the total volume of N_2O emissions for a set period;
- A relative limit on N_2O emissions expressed as a quantity per unit of output; or
- A threshold value for specific N_2O mass flow in the stack.

In this case, a corresponding plant-specific emissions factor cap (max. allowed $tN_2O/tHNO_3$) is to be derived from the regulatory level. If the regulatory limit is lower than the baseline factor determined for the project, the regulatory limit shall serve as the new baseline emissions factor, that is:

$$\text{If } EF_{BL} > EF_{reg} \qquad \textbf{(12)}$$

Then the baseline N_2O emission factor shall be EF_{reg} for all calculations.

Where:

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[39] The 'design' capacity means the total yearly capacity (considering 365 days of operation per year) as per the documentation of the plant technology provider (such as the Operation Manual). If the plant has been modified to increase production, and such de-bottleneck or expansion projects were completed before December 2005, then the new capacity is considered 'design', provided proper documentation of the projects is available

EF_{BL} = Baseline emissions factor ($tN_2O/tHNO_3$)
EF_{reg} = Emissions level set by newly introduced policies or regulations ($tN_2O/tHNO_3$).

D.1.3. Treatment of leakage in the monitoring plan:

not applicable

D.1.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project:

ID number *(Please use numbers to ease cross-referencing to D.2.)*	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.1.3.2. Description of formulae used to estimate leakage (for each gas, source etc.; emissions in units of CO_2 equivalent):

>>

not applicable

D.1.4. Description of formulae used to estimate emission reductions for the project (for each gas, source etc.; emissions/emission reductions in units of CO_2 equivalent):

The following equation is used for estimating the emissions reductions to be awarded to the project in this PDD, since the factual baseline and project emissions factors have not yet been established:

$$EF_{Pest} = EF_{BLPR} * (1 - AE) \qquad (kgN_2O/tHNO_3) \qquad \textbf{(13)}$$

Where:

Variable	Definition
EF_{Pest} =	Estimated Project Emissions Factor ($kgN_2O/tHNO_3$)
EF_{BLPR} =	Preliminary Baseline Emissions Factor, calculated in accordance with section A.4.3.1 ($kgN_2O/tHNO_3$)
AE =	Predicted Abatement Efficiency of secondary catalyst (%)

$$ERU_{PIS} = (EF_{BLPR} - EF_{Pest}) \times NAP_{yr} / 1000 \times GWP_{N2O} \qquad (tCO2e) \qquad \textbf{(14)}$$

$ERU_{PIS =}$	Estimated number of ERUs to be issued to the project (tCO2e)
$NAP_{yr =}$	Budgeted or Estimated Annual Nitric Acid Production ($tHNO_3$)
GWP_{N2O} =	Global Warming Potential of N_2O (310 tCO_2e/tN_2O)

D.1.5. Where applicable, in accordance with procedures as required by the host Party, information on the collection and archiving of information on the environmental impacts of the project:

For detailed information on good monitoring practice and performance characteristics see Annex 3.

D.2. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

Data *(Indicate table and ID number)*	Uncertainty level of data (high/medium/low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D.1.1.1.: *P1, P2, P3, P7, P8* *D.1.1.3:* *B1, B2, B3*	*low*	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181). Staff will be trained in monitoring procedures and a reliable technical support infrastructure will be set up. Third party audits by laboratories with EN ISO/IEC 17025 Accreditation

D.1.1.1: *P5,P6, P13* *D.1.1.3:* *B5, B6, B8, B9*	*low*	Calculated values included in evaluation by third party AIE
D.1.1.1: *P4, P9, P10* *D.1.1.3:* *B4,B7, B10*	*low*	Included in plant internal Quality Assurance program as validated by third party during ISO 9001/ ISO 14001 audit
D.1.1.1: *P11, P12, P14* *D.1.1.3* *B11, B12*	*low*	Constant factors included in evaluation by third party AIE

D.3. Please describe the operational and management structure that the project operator will apply in implementing the monitoring plan:

At the time of writing this PDD, the following people are responsible for the listed project tasks. However, it is possible that the responsible people may change throughout the course of the project activity.

General Project Responsibilities

Yara central project coordination:
Peter Fauconnier (TPO Nitric acid)
- AMS/General coordination

Oystein Nirisen (catalyst department)
- Catalyst development

N.serve:
Rebecca Cardani-Strange (Project Manager)
- Project Implementation and official project documentation

Martin Silkenbaeumer (Monitoring Specialist)

- Final data analysis, ERU calculations and project monitoring consultant

Köping Site Management & Local Project Responsibilities:

Site Management:

Jon Sletten (Site Manager)

- Overall political and project strategy

Pär Höök (Production Manager)

Lars-Håken Karlsson (HESQ Manager)

- Environmental permit responsibilities

Plant personnel:

Axel Pallin (Process Engineer)

- Project management/implementation
- Data collection

Mikael Larsson (Instrumentation Supervisor)

- Instrumentation calibration and maintenance

Jozef Meglic (Automation Engineer)

- Data collection and storage, back-up procedures

Operation, maintenance, calibration and service intervals are being carried out by staff from the instrument department according to the vendor's specifications and under the guidance of internationally relevant environmental standards, in particular EN 14181 (2004).

YARA Köping S3 has defined an AMS checking procedure schedule and will continue to plan ahead for the remaining years of the crediting period, strictly adhering to the relevant standards.

All monitoring procedures at YARA Köping S3 are also conducted and recorded in accordance with the procedures under ISO 9001, which is regularly audited by an independent auditing organisation accredited for ISO 9001 certification (see section D.1.)

D.4. Name of person(s)/entity(ies) establishing the monitoring plan:

N.serve Environmental Services GmbH
Grosse Theaterstr. 14
20354 Hamburg
Germany
www.nerve.net
contact@nserve.net

N.serve is listed as a project participant in Annex 1

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

Using the assumptions from section A.4.3.1 above, the following project emissions are estimated for the project activity in the crediting period. The first crediting period would start on the 1st May 2010. *Please note that all figures in the calculation tables have been rounded to the nearest tonne of CO2e. In view of the fact that the figures link directly to a detailed excel spreadsheet, the final total may not accord completely with the preceding figures*.

Crediting Period (year)	**Estimate of annual project emissions [tCO_2e]**
2010 (May to Dec)	22,155
2011	33,232
2012	33,232
Total estimated project emissions over the crediting period until end 2012 (tonnes of CO2 equivalent)	**88,619**
Annual average of project emissions over the crediting period until end 2012 (tonnes of CO2 equivalent)	**33,232**

Table 6 (part A): Estimated project emissions until 2012

Crediting Period (year)	**Estimate of annual project emissions [tCO_2e]**
2013	31,946
2014	31,946
2015	31,946
2016	31,946
2017	31,946
2018	31,946
2019	31,946
Total number of crediting years	10
Total estimated project emissions over the 10-yr crediting period (tonnes of CO2 equivalent)	**312,238**
Annual average of estimated project emissions over the 10-yr crediting period (tonnes of CO2 equivalent)	**31,224**

Table 7 (part B): Estimated project emissions from 2013 onwards

E.2. Estimated leakage:

No leakage emissions do occur.

E.3. The sum of E.1. and E.2.:

See E.1.

E.4. Estimated baseline emissions:

Business as usual emissions

As described in section A.4.3, in the business as usual scenario emissions would continue unabated at the current preliminary baseline emissions factor of 7.99kg/tHNO3 until the end of 2012. The figures in the table below show the emissions that would most likely occur in the absence of the JI project, taking into account the estimated conservative UNC deduction of 5% (in reality this figure is expected to be slightly lower).

Crediting Period (year)	**Estimate of annual BL Emissions (minus AMS uncertainty) [tCO_2e]**
2010 (May to Dec)	210,192
2011	315,289
2012	315,289
Total estimated baseline emissions over the crediting period until end 2012 (tonnes of CO2 equivalent)	**840,770**
Annual average of baseline emissions over the crediting period until end 2012 (tonnes of CO2 equivalent)	**315,289**

Table 8 (part A): Estimated baseline emissions until 2012

During the discussion period prior to the issuance of the most recent environmental permit, Yara Köping S3 reached an agreement with the Swedish EPA to reduce its emissions in the year 2013 to 2.5kg $N_2O/tHNO_3$, which is the so-called ‘split view’ factor resulting from the IPPC BAT reference document. In the unlikely event that N_2O is not covered under the EU ETS in the year 2013, the ‘baseline’ emissions from the 1st January 2013 onwards would therefore be represented by the value 2.5kg $N_2O/tHNO_3$.

Crediting Period (year)	**Estimate of annual BL Emissions (minus AMS uncertainty) [tCO_2e]**
2013	99,830
2014	99,830
2015	99,830
2016	99,830
2017	99,830
2018	99,830
2019	99,830
Total number of crediting years	**10**
Total estimated baseline emissions over the 10-yr crediting period (tonnes of CO2 equivalent)	**1,539,580**
Annual average of estimated baseline emissions over the 10-yr crediting period (tonnes of CO2 equivalent)	**153,958**

Table 9 (part B): Estimated baseline emissions from 2013 onwards.

* Due to the likely inclusion of N_2O emissions emanating from nitric acid production into the EU ETS from 1st January 2013 onwards, the project may not be eligible to earn ERUs after that time or continuing the project under the JI may not be economically viable. Also, from 2013 onwards a GWP of 298 for N_2O as defined by the IPCC Third Assessment Report will be applied. This is why this PDD differentiates in between prospective emission reductions achieved until 31st December 2012 and emissions reductions generated from 1st January 2013 onwards..

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

The ERU figures included in this PDD are *estimations* only. ERUs will therefore be awarded for those factual emissions reductions achieved below the UNC-corrected baseline emissions factor and subsequently verified by the responsible AIE, and not in accordance with the preliminary estimations provided in this PDD.

However, in accordance with the methodology AM0034, the maximum value of NAP eligible for ERU issuance “shall not exceed the design capacity. By nameplate (design) implies the total yearly capacity (considering 365 days of operation per year) as per the documentation of the plant technology provider”.

In the case of Syra 3, if the project participants were to calculate the maximum value of NAP eligible for ERUs in accordance with the above approach, the result would be as follows:

- daily design capacity: 418$tHNO^3$/day
- annual number of operating days: 348
- Total yearly capacity: 418 x 348 = 145,464$tHNO^3$

However, this figure of 145,464 is considerably higher than any of the factual annual production figures from the past five years and therefore is not considered sufficiently conservative as a cap on the NAP that is eligible for ERU issuance. The project participants have therefore been asked to restrict the NAP for which ERUs can be claimed to the highest of the factual annual historical production figures of the plant. The maximum amount of nitric acid produced by the plant in any one year was 134Kt HNO_3, rounded to the nearest Kt, (2006) and this shall therefore serve as the cap.

The below tables show the estimated emission reductions that will be generated by the project activity:

Crediting Period (year)	**Estimate of annual emissions reductions in tonnes of CO2 equivalent**
2010 (May to Dec)	188,038
2011	282,057
2012	282,057
Total estimated emission reductions over the crediting period until end 2012 (tonnes of CO2 equivalent)	**752,151**
Annual average of estimated emissions reductions over the crediting period until end 2012 (tonnes of CO2 equivalent)	**282,057**

Table 10 (part A): Estimated emissions reductions until 2012

Crediting Period (year)	**Estimate of annual emissions reductions in tonnes of CO2 equivalent**
2013	67,884
2014	67,884
2015	67,884
2016	67,884
2017	67,884
2018	67,884
2019	67,884
Total number of crediting years	10
Total estimated emission reductions over the 10-yr crediting period (tonnes of CO2 equivalent)	**1,227,342**
Annual average of estimated emissions reductions over the 10-yr crediting period (tonnes of CO2 equivalent)	**122,734**

Table 11 (part B): Estimated emission reductions from 2013 onwards

* Due to the likely inclusion of N_2O emissions emanating from nitric acid production into the EU ETS from 1st January 2013 onwards, the project may not be eligible to earn ERUs after that time or continuing the project under the JI may not be economically viable. Also, from 2013 onwards a GWP of 298 for N_2O as defined by the IPCC Third Assessment Report will be applied. This is why this PDD differentiates in between prospective emission reductions achieved until 31st December 2012 and emissions reductions generated from 1st January 2013 onwards.

E.6. Table providing values obtained when applying formulae above:

Please note that all figures in the calculation tables have been rounded to the nearest tonne of CO2e. In view of the fact that the figures link directly to a detailed excel spreadsheet, the final total may not accord completely with the preceding figures.

Year	**Estimated Project Emissions [tCO$_2$e]**	**Estimated Leakage [tCO2e]**	**Estimated Baseline Emissions [tCO$_2$e]**	**Estimated Emission Reductions [tCO$_2$e]**
2010 (May to Dec)	22,155	-	210,192	188,038
2011	33,232	-	315,289	282,057
2012	33,232	-	315,289	282,057
Total tonnes of CO2 equivalent	**88,619**	**-**	**840,770**	**752,151**

Table 12 (part A): Summary of calculation of estimated emissions reductions until 2012

Year	**Estimated Project Emissions [tCO$_2$e]**	**Estimated Leakage [tCO2e]**	**Estimated Baseline Emissions [tCO$_2$e]**	**Estimated Emission Reductions [tCO$_2$e]**
2013	31,946	-	99,830	67,884
2014	31,946	-	99,830	67,884
2015	31,946	-	99,830	67,884
2016	31,946	-	99,830	67,884
2017	31,946	-	99,830	67,884
2018	31,946	-	99,830	67,884
2019	31,946	-	99,830	67,884
Total tonnes of CO2 equivalent (2010 to 2020)	**312,238**	**-**	**1,539,580**	**1,227,342**

Table 13 (part B): Summary of calculation of estimated emissions reductions from 2013

* Due to the likely inclusion of N_2O emissions emanating from nitric acid production into the EU ETS from 1st January 2013 onwards, the project may not be eligible to earn ERUs after that time or continuing the project under the JI may not be economically viable.

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts of the project, including transboundary impacts, in accordance with procedures as determined by the host Party:

The project will reduce gaseous emissions of nitrous oxide (N_2O) from the plant tail gas and will therefore contribute to international efforts to reduce greenhouse gas emissions. The project will have no negative 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. Also, the project does not impact on the community's access to other natural resources, as it will not require any additional resources. In addition, there is no impact on the efficiency of resource utilization, nor is there any impact on the population living in the vicinity of the plant.
There are no other positive or negative impacts on the environment.

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

Given the facts stated in section F.1 above, no environmental impact assessment is necessary.

However, the installation of the catalyst must be reported to the local authorities "Miljökontoret Köpings Komun".

SECTION G. Stakeholders' comments

G.1. Information on stakeholders' comments on the project, as appropriate:

As the JI project does not have any relevance for local air, water or soil emissions, it is not necessary to undertake a local stakeholder consultation.

The Letter of Endorsement states that a public consultation will be conducted by the Swedish DFP before a final Letter of Approval is issued.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	YARA AB
Street/P.O.Box:	Storgatan 24, Box 516
Building:	
City:	Landskrona
State/Region:	
Postal code:	SE-261 24
Country:	Sweden
Phone:	+46 2212 7838
Fax:	
E-mail:	Jon.sletten@yara.com
URL:	http://www.yara.com
Represented by:	Jon Sletten
Title:	Site Manager, Yara Köping
Salutation:	Mr.
Last name:	Sletten
Middle name:	
First name:	Jon
Department:	
Phone (direct):	+46 2212 7838
Fax (direct):	
Mobile:	+46 48401746
Personal e-mail:	Jon.sletten@yara.com

Organisation:	N.serve Environmental Services GmbH (Germany)
Street/P.O.Box:	Große Theaterstr. 14
Building:	4. OG
City:	Hamburg
State/Region:	Hamburg
Postal code:	20354
Country:	Germany
Phone:	+49 40 3099786-0
Fax:	+49 40 3099786-10
E-mail:	Contact@nserve.net
URL:	http://www.nserve.net
Represented by:	Albrecht von Ruffer
Title:	Managing Director
Salutation:	Mr.
Last name:	von Ruffer
Middle name:	
First name:	Albrecht
Department:	
Phone (direct):	+49 (0)40 3099786-11
Fax (direct):	+49 (0) 40 3099786-10
Mobile:	+49 (0)177 6515964
Personal e-mail:	ruffer@nserve.net

Annex 2

BASELINE INFORMATION

Complete baseline information cannot yet be provided at the time of writing this PDD, since the baseline has not been completed. The measurement of the baseline started in November 2009 and it is therefore expected that complete baseline monitoring data will be available in May 2010.

Baseline assumptions

The table below shows the baseline assumptions made by the project participants prior to the implementation of the project activity. These figures are currently only predictions and estimates. They will be amended once full baseline and QAL2 AMS uncertainty data is available.

Koping S3, Sweden

		Units
HNO3 capacity	418	$tHNO_3/d$
Annual production	138,800	$tHNO_3/y$
Current N2O emissions	7.99	$kgN_2O/tHNO_3$
N2O baseline emissions per year	1,109	tN_2O
Global Warming Potential N2O	310	GWP
Annual N2O baseline Emissions	343,794	tCO2e
Predicted AMS Uncertainty	5%	Percent
UNC-deducted baseline emissions factor (rounded)	7.59	$kgN_2O/tHNO_3$
Catalyst abatement efficiency	90%	Percent
N2O project emissions factor (rounded)	0.80	$kgN_2O/tHNO_3$
UNC-deducted Annual CO2E Emission Reductions	**292,160**	**tCO2e**

Table 1: Baseline assumptions prior to project implementation

Parameters not monitored

Table 2: Parameters that are to be established prior to the first verification and are required to confirm applicability conditions.

	Parameter	*Unit*	*Source*	*Value*	*Comments*
P.1	*AFR_{max}* *Maximum ammonia flow rate*	*$kgNH_3/h$*	*Plant records from five campaigns between 05.11.2003 and 18.01.2006*		*Used to determine periods during the baseline campaign where the plant was operating outside of the permitted operating conditions.*

P.2	*$AIFR_{max}$* *Maximum ammonia to air ratio*	*%*	*Plant records from five campaigns between 05.11.2003 and 18.01.2006*		*Used to determine periods where the plant was operating a) outside the permitted operating conditions during the baseline campaign and b) outside the trip point range during the project campaigns.*
P.3	*CL_{normal}* *Average historic operating campaign length*	*$tHNO_3$*	*HNO_3 production data from five campaigns between 05.11.2003 and 18.01.2006*	*53,905*	*Defined as the average campaign length for the five historic campaigns used to define the operating conditions.*
P.4	*OT_{normal}* *Range for historic normal operating temperature*	*°C – min and max*	*Plant records from five campaigns between 05.11.2003 and 18.01.2006*		*Established after elimination of the upper and lower 2.5% percentiles of all data sets.* *Used to determine periods where the plant was operating a) outside the permitted operating conditions during the baseline campaign and b) outside the trip point range during the project campaigns.*
P.5	*OP_{normal}* *Range for historic normal operating pressure*	*Pa- min and max*	*Plant records from five campaigns between 05.11.2003 and 18.01.2006*		*Established after elimination of the upper and lower 2.5% percentiles of all data sets.* *Used to determine periods during the baseline campaign where the plant was operating outside of the permitted operating conditions.*

P.6	*GC_{normal}* *Gauze composition during historic operating campaigns*	*% of various metals*	*Plant documentation from five campaigns between 05.11.2003 and 18.01.2006, excluding the non-representative campaign 3.*	-	*The details of GCnormal are strictly confidential, but will be made available to the determining and verifying AIEs.*
P.7	*GS_{normal}* *Gauze supplier for historic operating campaigns*		*Plant documentation from five campaigns between 05.11.2003 and 18.01.2006*	*KAR Rasmussen*	*This information is used as a plausibility check against the information on Gauze Composition.*

Annex 3

MONITORING PLAN

Background on EN14181

The objective is to achieve the highest practically possible level of accuracy in conducting those measurements and transparency in the evaluation process.

While EN14181 provides the most advanced procedures, its practical application is currently limited for the following reasons:

- Specific procedures for N_2O are not yet defined in EN14181;
- Only very limited experience exists with monitoring systems for N_2O emissions;
- In the context of conducting some of the calculations and tests of EN14181, no applicable regulatory N_2O levels exist in the EU (or elsewhere).

Therefore, it is currently not possible to fully comply with the letter of EN14181, neither in the EU, nor in a non-Annex 1 country to the Kyoto Protocol.

Despite all this, EN14181 provides very useful guidance in conducting a logical, step-by-step approach to selecting, installing, adjusting and operating the N_2O AMS for CDM and JI projects.

The monitoring procedures developed for this project aim to provide workable and practical solutions that take into account the specific situation at each nitric acid plant. Wherever possible, EN14181 is applied as guidance for the development and implementation of the monitoring procedures for this JI project in order to achieve highest possible measuring accuracy and to implement a quality control system that assures transparency and credibility.

Scope of EN 14181

This European Standard specifies procedures for establishing quality assurance levels (QAL) for automated measuring systems (AMS) installed at industrial plants for the determination of the flue gas components and other flue gas parameters.

This standard is designed to be used after the AMS has been accepted according to the procedures specified in EN ISO 14956 (QAL1).

EN14181 specifies:

- a procedure (QAL2) to calibrate the AMS and determine the variability of the measured values obtained by it, so as to demonstrate the suitability of the AMS for its application, following its installation;
- a procedure (QAL3) to maintain and demonstrate the required quality of the measurement results during the normal operation of an AMS, by checking that the zero and span characteristics are consistent with those determined during QAL1;
- a procedure for the annual surveillance tests (AST) of the AMS in order to evaluate (i) that it functions correctly and its performance remains valid and (ii) that its calibration function and variability remain as previously determined.

This standard is restricted to quality assurance (QA) of the AMS, and does not include the QA of the data collection and recording system of the plant.

For a full description of the AMS to be installed at YARA Köping S3 nitric acid plant, as well as details on the quality assurance and control procedures to be undertaken, see section D.1 above.