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:

ACHEMA UKL-7 plant N_2O abatement project

PDD version: 05
Date: September 7, 2009

A.2. Description of the project:

Achema AB (akcine bendrove – stock company) is a manufacturer of chemicals based in Jonava, Lithuania. The company is the biggest nitrogen fertilizers producer in Lithuania. Company has over 1,500 employees and annual fertilizers production exceeds 2 million tons. There are tens of various items in Achema's product list – nitrogen and compound fertilizers, adhesives, paints, resins, industrial gases, other chemical products and intermediates. This project relates to the UKL-7 nitric acid production technology used in Achema for further processing and production of finalised goods.

Achema operates two nitric acid production lines, one manufactured by Grande Paroisse, the other by UKL. This project relates to the UKL-7 line. Nitrous oxide is an unwanted by-product of the process of oxidising ammonia to create nitric oxide, which is required for the production of nitric acid. The emissions of 1 tonne N_2O corresponds to 310 tonnes CO_2e.

The project involves the installation in each of eight ammonia burners in the UKL-7 line of secondary de-N_2O catalyst. Particular composition of the secondary catalysts shall be known after the recently undergoing selection procedure completion. In the presence of this catalyst, the N_2O is broken down into harmless constituents of N_2 and O_2.

A.3. Project participants:

Name of Party	Private project participants	Indicate whether the Party involved wishes to be considered as project participant
Lithuania	Achema AB	No

This project design document (PDD) has been developed by Vertis Environmental Finance Kft., which is also the JI project advisor.

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A.4. Technical description of the project:

A.4.1. Location of the project:

A.4.1.1. Host Party(ies):

Lithuania

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

Jonavos region

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

Jonalaukio village, Ruklos county

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

AB Achema plant is located near to town of Jonava at confluence of rivers Neris and Sventoji.

Picture 1

Source: www.maps.com

Picture 2

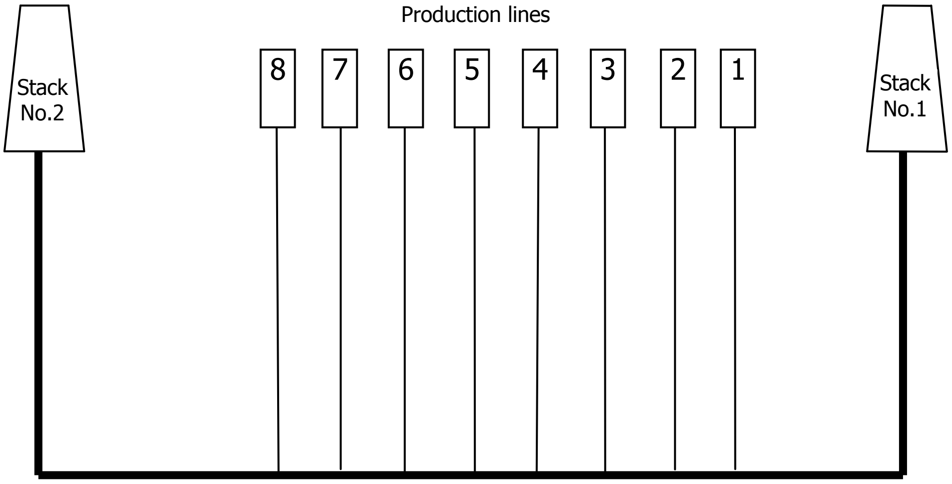
Source: www.maps.lt 1:112,000, Position: 55°04'42 N 24°18'53 E

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

Information on the plant

The UKL-7 nitric acid plant at Achema was constructed in 1972. The plant has a nameplate capacity of 2,800 tonnes of nitric acid per day of operation. UKL-7 plant consists of 8 separate production lines. Each line has its own ammonia and air preparation and feeding system, oxidation chamber, heat exchange system, turbine and absorption tower with individual production schedules (production, shut-downs, primary catalyst gauze changes, operating conditions). Tail gas ducts of individual production lines are connected to common tail gas duct which takes the tail gas to 2 stacks, from which N_2O is emitted to the atmosphere.

This is shown in the diagram below:
Diagram 1



Information on how nitrous oxide emissions occur

In the ammonia burners ammonia is burned with air in the presence of a precious metals Platinum/Rhodium catalyst (the “primary catalyst”) which is located within the burner. In the presence of the primary catalyst, nitrogen combines with oxygen to form nitric oxide (NO). However, at the same time other reactions occur, some of which lead for the formation of N_2O. These equations are listed below, N_2O forming equation is latest.

$$4\ NH_3 + 5\ O_2 \leftrightarrow 4\ NO + 6\ H_2O$$

$$4\ NH_3 + 3\ O_2 \leftrightarrow 2\ N_2 + 6\ H_2O$$

$$4\ NH_3 + 4\ O_2 \leftrightarrow 2\ N_2O + 6\ H_2O$$

Technology employed

There are two types of technologies for the catalytic decomposition of N_2O, both of which are rather new, and there is only limited industrial experience with the use of these catalysts: the secondary catalyst which is installed in the main ammonia oxidation chamber beneath the main platinum gauzes for producing NO; and the tertiary catalyst which is contained in a separate vessel into which the tail gas from the oxidation chamber are conducted.

In the presence of the secondary catalyst at temperatures zone between 800°C and 950°C, the N_2O breaks down into N_2 and O_2 following the reaction:

$2N_2O = 2N_2 + O_2$

Neither of these gases are greenhouse gases. A secondary N_2O de-composing catalyst will be installed beneath the primary catalyst. Secondary catalyst will be placed in the appropriate support structure. The gap between the edge of the support structure and inside wall of the ammonia burner will be sealed to prevent gasses avoiding passing around the secondary catalyst. In this way the technology will ensure that all gases which pass through the primary catalyst also will pass through the secondary catalyst.

The secondary catalyst causes approximately from 70% up to 95% of the N_2O to be destroyed.

The technology is provided by a major secondary catalyst manufacturers. Secondary catalysts have been installed on all 8 lines of the UKL-7 plant from April 2008 through December 2008.

For information about the technology installed for measuring and recording the emissions of nitrous oxide from the plant, see the section D.1.2. below.

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:

Brief description of additionality discussed in B.2.
IPPC permit issued to Achema (as updated on April 30, 2008) creates a degree of balance between voluntary actions taken by Achema and mandatory emission limit values imposed into the IPPC permit. Gradual imposition of emission limit values according to a realistic implementation schedule of N_2O abatement techniques generates significant environmental benefit because this is compatible with JI and so reductions begin as soon as the JI project is implemented.

If the regulatory limit would be lower than the baseline emission factor determined for the project, the regulatory limit would serve as the new baseline emission factor.

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

	Years
Length of the crediting period	
Year	Estimate of annual emission reductions in tonnes of CO_2 equivalent
2008	538,953
2009	1,048,397
2010	1,048,397
2011	1,048,397
2012	1,048,397
Total estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	4,732,541
Annual average of estimated emission reductions over the crediting period (tonnes of CO_2 equivalent)	946,508

A.5. Project approval by the Parties involved:

A host country Letter of Approval was issued by the Lithuanian Ministry of Environment on May 11, 2009.

SECTION B. Baseline

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

Summary description of the baseline

The baseline methodology is based on Clean Development Mechanism (CDM) methodology AM0034/Version 02. Certain small modifications are made to AM0034/Version 02 which allow the baseline factor to be established and GHG emission reductions to occur in shorter time than would occur with AM0034/Version 02.

The baseline chosen is the level of nitrous oxide emissions of the plant in the absence of the project. It reasonably represents the anthropogenic emissions by sources that would occur in the absence of the project. Baseline covers Greenhouse gas (GHG) emissions from all sources within the project boundary. Baseline is established on the project-specific basis. Baseline emissions factor has been established in a transparent manner based on measurements and data calculations described later in this document. Baseline takes into account all relevant national and sectoral policies and circumstances. Baseline chosen does not allow the project to earn emission reduction units (ERUs) for decreases in activity levels outside the project activity or due to force majeure. Baseline takes into account uncertainties and uses conservative assumptions.

Specific design of the UKL plant necessitates certain amendments to AM0034/Version 02, such as measurement of N_2O concentrations in the tail gas ducts after expansion turbines instead of joint stacks because of different campaign cycles (i.e. different primary catalysts ageing) of all 8 production lines. Specifics of the baseline measurements are described precisely in the monitoring plan.

Justification of the methodology

This baseline approach is used for the following reasons:

1. It is based on an approved CDM methodology and therefore incorporates a level of scientific rigour which has already been approved by the UNFCCC methodology panel
2. It meets the conditions of applicability of AM0034/Version 02 since:
   a. The facility was established before 31st December 2005
   b. The facility had no existing N_2O abatement technology at time of the JI project start, hence, no impact on the work of it could be done by the project activity
   c. The project will not affect the plant's nitric acid production levels
   d. The project is additional to legal requirements applicable to N_2O emissions to the extent defined in IPPC permit
   e. There was no N_2O abatement technology installed at the plant at time of the JI project start
   f. The project activity will not increase NO_x emissions
   g. There is no non-selective catalyst installed for the reduction of NO_x
   h. The project will not lead to any material change in other greenhouse gas emissions within the project boundary
   i. Continuous monitoring of the N_2O concentration and tail gas flow has been installed for the duration of a campaign for the measurement of baseline emissions, and thereafter
3. Our approach leads to more emission reductions than a strict application of AM0034/Version 02 since it allows for earlier installation of a secondary catalyst and therefore starts destruction of N_2O emissions sooner.

In the Identification of the baseline scenario we list first barriers named in the AM0028 methodology and we specifically mark cases, when some of these barriers do not apply to the project.

Identification of the baseline scenario

For identification of the baseline scenario the procedure of the CDM methodology AM0028/Version 04.1 has been used, in accordance with the suggestion of the CDM methodology AM0034/Version 02.

Step 1a

Step 1a of a baseline scenario identification includes listing of all technically feasible alternatives to the given project. The principal theoretical alternatives to the project are:

- Continuing to operate the plant as is
- 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 Non-Selective Catalytic Reduction (NSCR) De-NO_x system
- Installation of N_2O abatement not as a JI project
- 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

Step 1b

This step includes all possible technically feasible options to handle NO_x emissions. Non-Selective De-NO_x units cause also reduction of N_2O and thus it is necessary to elaborate also on this technical option. Possibilities regarding NO_x emissions are as following:

- Continuation of the current situation, whether either De-NO_x units is installed or not
- Installation of new Selective Catalytic Reduction De-NO_x unit
- Installation of a new Non-Selective Catalytic reduction (NCSR) De-NO_x unit
- Installation of a new tertiary measure that combines NO_x and N_2O emission reduction

Step 2

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

NO_x emissions are regulated by the Approval of Integrated Pollution Prevention and Control No. 4/15-04 (IPPC) requiring to keep concentration of NO_x emissions below 50 ppmV level. Achema has installed at all 8 production lines a Selective Catalytic Reduction De-NO_x units:

UKL-7/1-November, 2000
UKL-7/2-October, 2000
UKL-7/3-September, 2000
UKL-7/4-June, 2001
UKL-7/5-June, 2000
UKL-7/6-February, 2001
UKL-7/7-March, 2003
UKL-7/8-December, 2004

Achema complies with above defined concentration limit of 50 ppmV NO_x concentration. Below is table containing average values (based on calculation of 3 months measurements) of NOx concentration per line in the UKL-7 plant.

Table 1

UKL-7 plant	NOx data average, ppm
UKL-1	35
UKL-2	42
UKL-3	36
UKL-4	38

UKL-5	37
UKL-6	33
UKL-7	35
UKL-8	34

All alternatives could comply with relevant legal regulations.

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

Step 3a
On the basis of the alternatives that are technically feasible and in compliance with all legal and regulatory requirements establish a complete list of barriers that would prevent alternatives to occur in the absence of JI. Barriers include, among others:

- Investment barriers, *inter alia*:
    - Debt funding is not available for this type of innovative project activity
    - Debt funding is not available due to no project return without JI
    - No access to international capital markets due to perceived risks associated with domestic or foreign direct investment in the country where the project activity is to be implemented (n.a.)

- Technological barriers, *inter alia*:
    - Technical and operational risks of alternatives
    - Technical efficiency of alternatives (e.g. N_2O destruction, abatement rate)
    - Skilled and/or properly trained labour to operate and maintain the technology is not available and no education/training institution in the host country provides the needed skill, leading to equipment disrepair and malfunctioning (n.a.)
    - Lack of infrastructure for implementation of the technology (n.a.)

- Barriers due to prevailing practice, *inter alia*:
    - The project activity is the “first of its kind”: No project activity of this type is currently operational in the host country or region

Since Lithuania is the EU Member State with corresponding level of industrial development we have used for elimination of possible alternatives mainly technical and operational risks of alternatives and technical efficiency of alternatives criteria (i.e. there is no barrier in form of no access to international capital markets, lack of infrastructure or lack of skilled personnel as Achema is capable of implementing and operating a de-N_2O project).

Nitric acid production in industrial facilities such as Achema plant is not possible to be changed in a way not involving the ammonia oxidation process.

Alternative use of N_2O is neither technologically nor economically feasible. It is not possible to recycle N_2O in order to use it for the nitric acid production, neither it is technically and economically feasible to use N_2O for external purposes.

Installation of NSCR is also not feasible from technological and economic points of view due to high energy costs, high gas temperatures required, emissions of CO and hydrocarbons to the air. N_2O emission levels are also higher than with Selective Catalytic Reduction (SCR) and it is a very expensive abatement technology both in terms of investments and operation costs. The Achema plant has installed selective catalyst reduction system which reduces NO_x emission level below the limits established by Achema's IPPC permit.

Since reduction of N_2O represents significant investments for installation, burner modifications and following costs of operation of the N_2O emission reduction system consisting of secondary catalysts (De-N_2O system) it is not economically feasible to implement a De-N_2O project without use of financing provided through JI.

Tertiary De-N_2O reduction is not economically feasible in the Achema plant as it would require principal changes to complete design of nitric acid production lines and NO_x emissions abatement is handled by installation of Selective Catalytic reduction unit.

Recent level of the ammonia oxidation catalyst development does not allow to implement de-N_2O project using primary catalyst as the De-N_2O reduction component.

It is important to note that Achema by implementation of the de-N_2O project contributes to environmentally friendly innovativeness of the chemical industry, nitric acid production specifically.

Recently there are no operational secondary catalyst de-N2O projects in the region and there is no experience with operation of secondary catalyst inside UKL-7 type oxidation burners.
By January 2009 there have been published on the UNFCCC website (http://ji.unfccc.int/JI_Projects/Verification/PDD/index.html) in total 17 de-N_2O projects, which have proceeded into the PDD publication stage.

Step 3b
Based on the reasons listed in the Step 3a above we have eliminated in this step following alternatives:

- 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 Non-Selective Catalytic Reduction (NSCR) De-NO_x system
- Installation of N_2O abatement not as a JI project
- Installation of an N_2O destruction or abatement technology:
    - Tertiary measure for N_2O destruction
    - Primary measures for N_2O destruction or abatement

Only remaining alternative achieving N_2O emission reduction, other than continuation of Status Quo, is secondary catalytic reduction of N_2O in existing reaction chambers of ammonia oxidation reactors.

Step 4
Identify the most economically attractive baseline scenario alternative
Implementation of installation of the secondary De-N_2O catalyst, itself does not generate any financial profit. Since it is only alternative left after elimination of other alternatives in steps 2 and 3, it is not necessary to conduct further simple cost analysis, which would otherwise appropriate to this alternative.

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

Sub-step 5a
Achema nitric acid plant has installed a Selective Catalytic Reduction De-NO_x units in order to comply with existing NO_x regulations in Lithuania. SCR De-NOx unit leads to higher N_2O formation and its

intensification would lead to higher emission reductions. Thus change in the NOx regulations would not necessitate re-assessment of the Baseline Scenario, because it would actually increase its level of required conservativeness.

Sub-step 5b
In case of introduction of either concentration or mass limits of N_2O emission the Baseline Scenario would be re-assessed according to new regulations.

Note on variation on AM0034/Version 02 for application on this project

1. Overlapping of consecutive campaigns

AM0034/Version 02 requires that the baseline factor should be established through measuring emissions during an entire campaign. The plant has eight separate lines, and the timing of the campaigns of these lines is staggered.

Instead of this approach, measuring of emissions from all lines began in August 2007. Emissions are measured for each line right up the end of the campaign which was in progress at the time the monitoring system was installed. Note that campaigns at different lines end at different times because of the staggering of campaigns. Measurements of emissions continue into the subsequent campaigns for each line until such time as the total volume of nitric acid produced from which emissions had been measured in previous campaign on each line equalled volume of nitric acid produced of a standard campaign.

The primary catalyst and operating conditions during the first campaign are materially the same as those of the subsequent campaign.

In this way data for calculating emission factor are obtained from two separate but consecutive campaigns with identical operating conditions:

(i) Emissions factor for the last x hours of the first campaign. During this period, at the end of the campaign, the NO yield is lower and the N_2O emissions are higher.
(ii) Emissions factor for the first y hours of the subsequent campaign. During this period, at the beginning of the campaign, the NO yield is higher and the N_2O emissions are lower.

2. Multiple lines

The plant is designed with eight lines each comprising one production unit of burner, absorption tower, De-NO_x system, and tail gas turbine. The emissions from the eight tail gas turbines are led to a common stack bar and emitted to the air through two stacks.

Because of this, baseline emissions are measured separately from each line and a separate baseline factor is calculated for each line. Similarly, project emissions are recorded for each line. The number of emissions reductions of the project is the sum of emission reductions for each of separate lines.

Also because of the design of the plant, concentration of nitrous oxide and flow of tail gasses are not measured in the stacks. They are both measured in the duct immediately after the expansion turbine and before the common stack bar. This ensures that emissions from the individual lines are separate and not mixed, but also at below 300 degrees centigrade at which temperature N_2O is stable and no further natural decomposition will take place.

3. Uncertainty

The nitrous oxide concentration is measured on a switched basis when one N_2O concentration analyser serves 3 production lines. The reason for this is the limitation of the capacity of the hardware of the monitoring system. As a result of this there is a small increase in the uncertainty of the monitoring system. To reflect this in the calculation of baseline emissions and project emissions, an additional uncertainty factor defined by the QAL2 test carried out in accordance with the EN14181 norm is incorporated into the calculation of the overall uncertainty factor of the Automated Monitoring System.

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:

This section provides proofs of the project additionality, i.e. proofs demonstrating importance of the JI project implementation for greenhouse gas reduction that would not have been achieved in the business-as-usual scenario. *"Tool for the demonstration and assessment of additionality"* (version 04) as issued by CDM Executive Board is used as a reference for proving attractiveness of chosen JI project alternative in front of other possible alternatives.

Step 1

Identification of alternatives to the project activity consistent with current laws and regulations

As suggested by the CDM methodology AM0034/Version 02 Step 1 has been omitted because B.1 section identifying and describing baseline scenario has already identified continuation of the Status Quo as the only realistic alternative to the chosen project scenario, which is also consistent with mandatory laws and regulations of Lithuania.

Step 2

Investment analysis

Investment analysis is the next step undertaken in order to prove the necessity of ERUs revenues for the project implementation that otherwise would not be financially attractive.

As described in section "Identification of the baseline scenario", in the absence of the JI project, there is no installation of any equipment which would reduce N_2O emissions, and the business continues as usual. This means that there is no reduction of N_2O emissions and they would remain at recent level.

Step 3

Barrier analysis

Step 3 is omitted because the *"Tool for the demonstration and assessment of additionality"* (version 03) allows the use of alternatively Step 2 or Step 3 for the proof of additionality.

Step 4

Common practice analysis

This step allows to double check for the previous proofs of the project additionality demonstrating that besides being the only plausible alternative from financial point of view the project also introduces innovative practice in the industry of the region regarding greenhouse gas abatement activity.

Introduction of N_2O abatement technology is not common practice for nitric acid industry. It should be noted, that Achema is only nitric acid producers in the Baltics region, which could be used as comparative framework for assessment of common practice aspect of the project. In case of Lithuania, in particular, high costs of project implementation make N_2O abatement activity to be not attractive for local nitric acid production industry. On the other hand N_2O abatement activity is known to be widespread practice among nitric acid plants implemented as CDM or JI projects, which proves this activity to be rather attractive in a framework of Kyoto Protocol project flexibility instruments.

Conclusion

Implementation of the N_2O abatement project in the JI framework is the only way to make the introduction of N_2O abatement technology financially feasible for the plant. Installation of the secondary

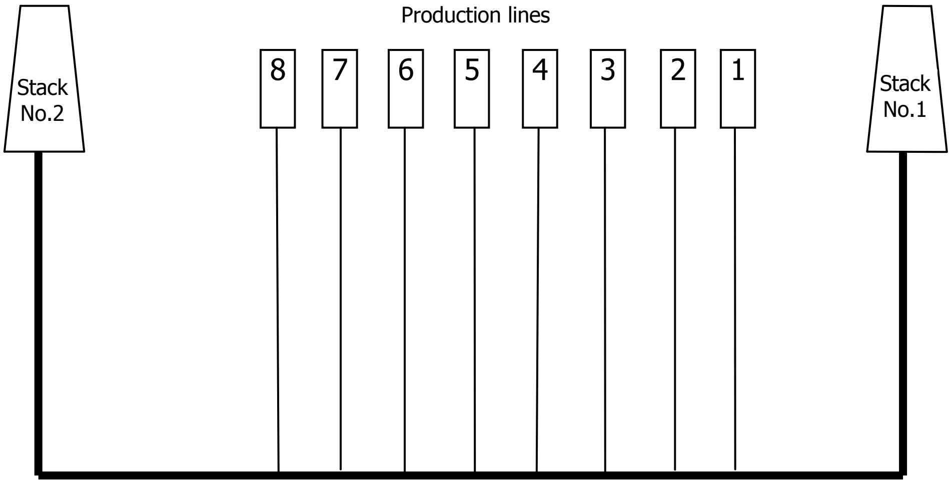
N_2O abatement catalyst is state-of-art technology, hence, not widely spread among nitric acid production plants. Because of its modernity this technology is quite costly and it does not represent for the plant any financial benefit. The only advantage of N_2O abatement is reduction of this potential greenhouse gas in order to introduce climate change mitigation measures. JI project implementation and the use of ERUs sale proceeds is the only possible solution for reducing N_2O emissions at the nitric acid plant of Achema earlier than as it is set in the IPPC permit.

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

Project boundary encompasses all anthropogenic emissions by sources of GHGs which are under the control of project participants, are reasonably attributable to the project and are significant. Project boundary and greenhouse gas sources relevant for the project implementation are individuated in accordance with the Approved Consolidated Methodology AM0034/Version 02 “Catalytic reduction of N_2O inside ammonia burner of nitric acid plants”.

According to the methodology the project boundary shall cover the facility and equipment for the complete nitric acid production process. The following diagram identifies the borders where N_2O emission reduction project will take place on eight nitric acid production lines. The process of nitric acid production and N_2O abatement is identical on eight production lines. The inlet of ammonia into the ammonia oxidation reactors of all eight lines is the first point in the project boundary and the gas emission from the stacks is the last point in the nitric acid production process included into the project boundary.

Diagram 2



The only greenhouse gas to be considered in the implementation of the N_2O abatement project at the nitric acid plant is the N_2O.

Table 2

	Source	Gas	Inclusiveness	Justification /Explanation
Baseline	Nitric Acid Plant (Burner inlet to stack)	CO_2	Excluded	N_2O abatement project does not lead to any change in CO_2 and CH_4 emissions
		CH_4	Excluded	
		N_2O	Included	
Pr	Nitric Acid Plant (Burner	CO_2	Excluded	N_2O abatement project does not lead to

	inlet to stack)	CH_4	Excluded	any change in CO_2 and CH_4 emissions
		N_2O	Included	
	Leakage emissions from production, transport, operation and decommissioning of the secondary catalyst.	CO_2	Excluded	No leakage emissions are expected.
		CH_4	Excluded	
		N_2O	Excluded	

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

Baseline will be set after completion of complete measurements carried out during time equal to normal length of entire project campaign and verified at time of first periodic verifications. Estimated date for baseline setting is March 2009 for lines with completed first project campaigns and rest at time after completion of their first project campaigns. Information on baseline emission factors set will be part of first monitoring reports to be prepared for these lines .

Baseline will be set by:

Contact person	Laszlo Pasztor
Company	Vertis Finance Kft
Project participant	No
Address	H-1123 Budapest, Alkotás utca 39/c, Hungary
Phone	+36 1 488 8415
Fax	+36 1 488 8411
Email	laszlo.pasztor@vertisfinance.com
Web page	www.vertisfinance.com

SECTION C. Duration of the project / crediting period

C.1. Starting date of the project:

December 2006

C.2. Expected operational lifetime of the project:

The project is expected to operate beyond 31st December 2012.

C.3. Length of the crediting period:

The period for crediting of ERUs is from 1st January 2008 to 31st December 2012.

SECTION D. Monitoring plan

D.1. Description of monitoring plan chosen:

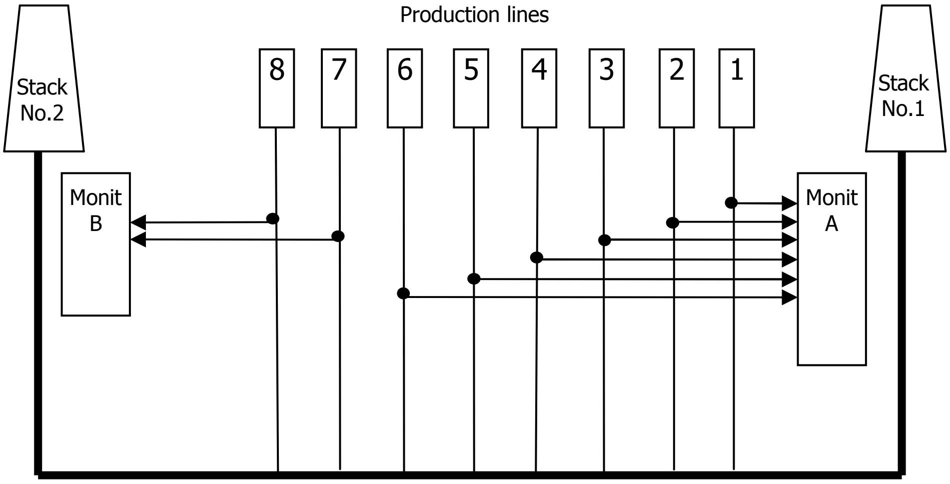
PURPOSE OF THE MONITORING PLAN

The purpose of the monitoring plan is to describe the system used to monitor emissions of N_2O from the plant in such a way that is compliant with the prescriptions of the AM0034/Version 02.

PLANT DESCRIPTION

The UKL-7 nitric acid plant comprises recently 8 production lines numbered from 1 through 8, each with its own burner, absorption column and expansion turbine. Each production line represents a separate nitric acid production unit independent from each other. The tail gasses from each line are after expansion turbines led to a common stack bus and vented through two interconnected stacks.

Diagram 3



Primary catalyst is changed at different times thus it is necessary to measure the emissions from each line individually. This means that eight separate sets of monitoring equipment are installed to measure tail gas flow, nitric acid production, nitric acid concentration, and the operating conditions. N_2O concentration in the tail gas is measured by 3 switched concentration meters.

MONITORING SYSTEM ARCHITECTURE

Methodology AM0034/Version 02 requires installation of an N_2O monitoring system that includes both a gas volume flow meter to determine the tail gas mass volume flow and an infrared gas analyser to determine the concentration of N_2O.

But tail gas N_2O concentration meter and tail gas volume flow meter alone are not sufficient for a JI project purposes. In order of being able to calculate the baseline emission factor expressed as tonnage of N_2O in t CO_2e per 1 tonne of HNO_3 (100%), it is necessary to include also HNO_3 measurement, and in order of being able to document normal operating conditions it is necessary to include also operating conditions measurement.

Because of this we use the term Monitoring System (MS) to describe entire monitoring system directly and indirectly used for the JI purposes, while Automated Measurement System (AMS) covers only N_2O emissions and tail gas mass volume part of the MS.

Monitoring System (MS) for purpose of this monitoring plan means:

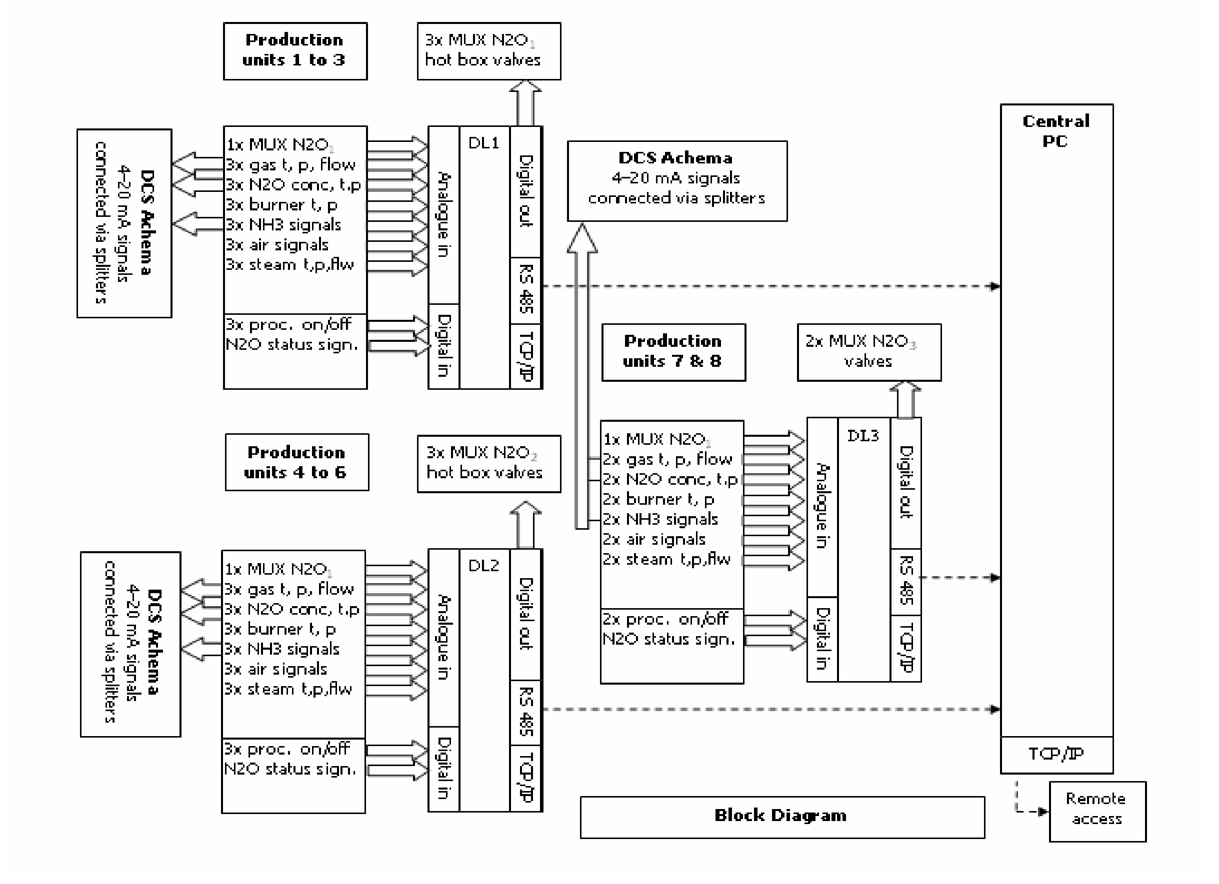
1. monitoring system measuring operational conditions;
    a. Ammonia volume flow
    b. Ammonia temperature
    c. Ammonia pressure
    d. Primary air volume flow
    e. Primary air temperature
    f. Primary air pressure
    g. Oxidation temperature
    h. Oxidation pressure

2. nitric acid 100% concentrate production;
    a. Nitric acid concentration
    b. Nitric acid flow
    c. Nitric acid temperature

3. and newly installed measurement devices for measurement of N_2O concentration and tail gas flow, temperature and pressure (AMS)
    a. N_2O concentration in the stack
    b. Stack volume flow rate
    c. Stack gas temperature
    d. Stack gas pressure

Incorporation of the AMS into the MS by interfacing already existing and newly installed measurement devices is documented by the diagram below.

Diagram 4



N_2O automated measurement system

Main purpose of the N_2O automated measurement system (AMS) is to measure total mass of N_2O emitted during particular campaigns (both baseline and project). In order of calculation of total mass of N_2O emitted during particular campaign it is necessary to measure on an extractive basis the N_2O concentration in a tail gas and on a non-extractive basis tail gas flow, pressure and temperature.

N_2O concentration

N_2O concentration is measured by extractive measurement system. Tail gas samples are taken from respective tail gas ducts at sampling points located after expansion turbines and transported by sample lines to the Monitoring room A located next to the main production hall. This applies to 2 concentration meters measuring lines 1-3 and lines 4-6. Lines 7-8 are measured by third concentration meter located at the other side of the production hall (Monitoring room B) physically closer to respective production lines 7 and 8.

Tail gas samples are filtered and conditioned in the condensation dryer (4°C), so N_2O concentration is measured on a dry basis. Correction of dry basis ppmV value to real wet tail gas conditions based on steam flow injected into the system is part of both - the project emissions calculations and baseline emission factor calculations.

N_2O concentration is measured by concentration infrared absorption principle meters Xentra 4900 using GFX monitoring technology.

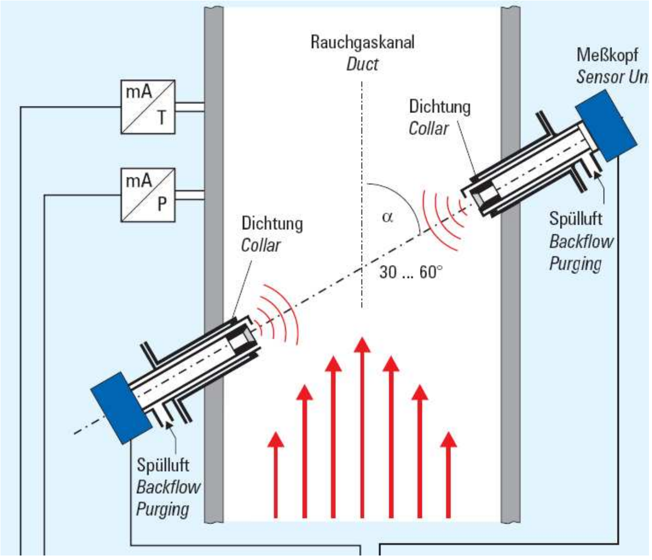
Recently there are 8 production lines. N_2O concentration is measured by 3 concentration meters on a switched basis. Under-sampling uncertainty is part of both - the project emissions calculations and baseline emission factor calculations.

N_2O concentration measured data are sent from the concentration meter on a 2 sec basis in a form of 4-20mA signal to the datalogger and processed further.

<u>Tail gas flow, pressure and temperature</u>

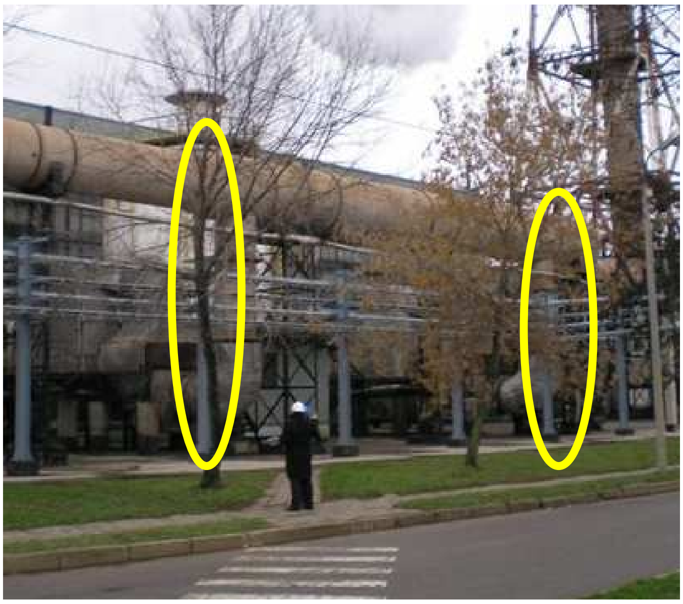
Tail gas flow is measured by ultrasonic Durag DF-L 200 flowmeters based on ultrasonic pulse fly time across the entire duct cross-section.

Picture 3



The tail gas ducts do not allow any optimum location to perform the flow monitoring. The only possible location is the quite short vertical tube behind the 90° “knee”.

Picture 4



Since the flow is not really laminar, a classical Pitot tube one point solution wouldn't allow good results. The ultrasonic system is under these conditions superior to differential pressure. Cross duct monitoring is more accurate than a couple of discrete point averaged pressure.

Tail gas flow, pressure and temperature measured data are sent from the flow meter on a 2 sec basis in a form of 4-20mA signal to the datalogger and processed further.

EN14181 compliance

As required by the AM0034/Version 02 methodology the N_2O automated measurement system (AMS) complies with requirements of the technical norm EN14181. N_2O AMS consists from the N_2O concentration meter and integrated flowmeter (F, T, P). Both measurement devices are QAL1 certified (concentration meter for the N_2O measurand specifically) and after full commissioning of the monitoring system there was the QAL2 test carried out by an independent laboratory Airtec based in Germany and certified according to ISO17025 (http://www.airtec-umwelt.de).

Operating conditions

For purpose of the baseline emissions factor setting it is necessary to monitor and report operating conditions in all 8 burners. Namely:

- Ammonia flow
- Ammonia temperature
- Ammonia pressure
- Primary air flow
- Primary air temperature
- Primary air pressure
- Oxidation temperature
- Oxidation pressure

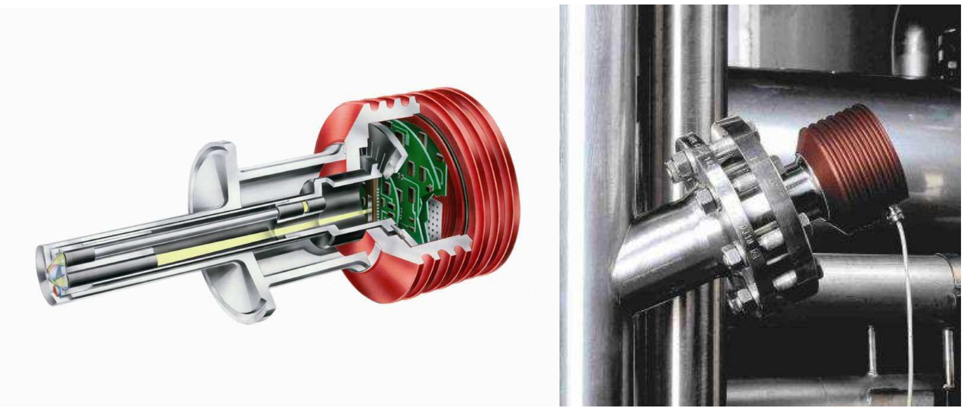
All these parameters are measured by the plant monitoring system. Signals obtained from these measurement devices from production lines 1-6 are converted from pneumatic to 4-20mA analog signals. Operating conditions measurement devices installed in production lines 7-8 provide the 4-20mA signals which are digitalized and provided to the monitoring system dataloggers, which process them further.

Nitric acid production

Nitric acid concentration is based on two components: nitric acid and water. Standard monitoring method is on-line refractometry. Measurement of nitric acid (100%) mass volume production per campaign is necessary for calculation of the baseline emissions factor. Nitric acid concentration on all 8 lines is measured by K-Patents PR-23-GP refractometers.

This analyzer is applying a prism to "return" a generated optical beam back to an LCD detector.

Picture 5



The detector is measuring refraction of monitored liquid based on known refraction of water and nitric acid. The instrument is calibrated for percent concentration of nitric acid. The analyzer is mounted on DIN-flange 2656, PN25 DN80. The optical prism does not require cleaning.

PR-23-GP characteristics:

- Measuring RI is a direct concentration measurement principle. No need to rely or convert magnitudes.
- Digital instrument – no calibration drift
- As it is a robust instrument it is maintenance free
- Dual connectivity if the installation positions allow.
- On-line data logging, through Ethernet, on whichever web browser.
- No influence by bubbles or particles. It is very common that air enters the process pipeline and still the refractometer measures accurately.

Nitric acid concentration data are in an analog 4-20mA format provided to dataloggers which process these signals further.

In order of being able to calculate total mass volume of nitric acid 100% concentrate produced during the baseline campaign it is necessary to monitor also nitric acid flow and temperature. Measurement of pressure is not necessary for determination of the nitric acid mass volume flow, because nitric acid is in form of liquid and as such it has stabile pressure characteristic.

Signals obtained from the nitric acid flow and temperature measurement devices from production lines 1-6 are converted from pneumatic to 4-20mA analog signals. Nitric acid flow and temperature measurement devices installed in production lines 7-8 provide the 4-20mA signals which are digitalized and provided to the monitoring system dataloggers, which process them further.

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	$NCSG_l$ N_2O concentration in the stack gas for particular line (l=1,2,3……8)	N_2O analyser Xentra 4900 QAL1 certified	mgN_2O/m^3 (converted from ppmV)	m	Every 2 seconds	24% (Lines 1-6) 36% (Lines 7-8) *To be defined exactly after baseline measurements completion*	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
P.2	VSG_l Volume flow rate of the stack gas for particular line (l=1,2,3……8)	Gas volume flow meter Durag DF-L 200 QAL1 certified	m^3/h	m	Every 2 seconds	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
P.3	$PE_{n,l}$ N_2O emissions of nth project campaign for particular line (l=1,2,3……8)	Calculation from measured data	tN_2O	c	After every project campaign	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
P.4	OH_l Operating hours for particular line (l=1,2,3……8)	Monitoring system	Hours	m	Daily, compiled for entire campaign	100%	Paper for at least 2 years after end of the crediting period or last ERUs issuance	

P.5	NAP_l Nitric acid production (100% concentrate) for particular line (l=1,2,3……8)	Production log	$tHNO_3$	m	Daily, compiled for entire campaign	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
P.6	TSG_l Temperature of stack gas for particular line (l=1,2,3……8)	Probe (part of gas volume flow meter)	°C	m	Every 2 seconds	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
P.7	PSG_l Pressure of stack gas for particular line (l=1,2,3……8)	Probe (part of gas volume flow meter)		m	Every 2 seconds	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
P.8	$EF_{n,l}$ Emission factor calculated for n^{th} campaign for particular line (l=1,2,3……8)	Calculated from measured data	$tN_2O/tHNO_3$	c	After end of each campaign		Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
P.9	$EF_{mn,a,l}$ Moving average emissions factor for particular line (l=1,2,3……8)	Calculated from campaign emissions factors	$tN_2O/tHNO_3$	c	After end of each campaign		Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	For the first campaing EF and EF_x will be equal
P.10								
P.11								

P.12	$CL_{n,l}$ Campaign length for particular line (n=1,2,3……8)	Calculated from nitric acid production data	$tHNO_3$	c	After end of each campaign	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
P.13	$EF_{p,l}$ Emissions factor used to determine emissions reductions for particular line (l=1,2,3……8)	Determined from campaign emissions factors	$tN_2O/tHNO_3$	c	After end of each campaign		Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	Determined from campaign emissions factors
P.14	$EF_{min,l}$ Minimum emissions factor after 10 campaigns for particular line (l=1,2,3……8)	Determined from campaign emissions factors	$tN_2O/tHNO_3$	c	After end of 10th campaign		Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	Determined from campaign emissions factors

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

Over the duration of the project activity tail gas volume flow in the stack of the nitric acid plant as well as the temperature and pressure of ammonia gas flow and ammonia-to-air ratio on eight nitric acid production lines measured continuously. N_2O concentration will be measured on the switched basis.

Estimation of campaign-specific project emissions

The monitoring system was installed using the guidance document EN 14181 and provides separate readings for N_2O concentration and gas flow volume for every hour of operation. Error readings (e.g. downtime or malfunction) and extreme values are eliminated. Same statistical evaluation that was applied to the baseline data series will be applied to the project data series:

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

$PEn = VSG * NCSG * 10^{-9} * OH$ (tN_2O)

where::

Variable	**Definition**
VSG	Mean stack gas volume flow rate for the project campaign (m^3/h)
NCSG	Mean concentration of N_2O in the stack gas for the project campaign (mgN_2O/m^3)
PE_n	Total N_2O emissions of the n^{th} project campaign (tN_2O)
OH	Is the number of hours of operation in the specific monitoring period (h)

Derivation of a moving average emission factor

In order to take into account possible long-term emissions trends over the duration of the project activity and to take a conservative approach a moving average emission factor will be estimated as follows:

Step1: campaign specific emissions factor for each campaign during the project's crediting period will be estimated by dividing the total mass of N_2O emissions during that campaign by the total production of 100% concentrated nitric acid during that same campaign.

For example, for campaign n the campaign specific emission factor would be:

$EF_n = PE_n / NAP_n$ ($tN_2O/tHNO_3$)

Step 2: moving average emissions factor to be calculated at the end of a campaign n will be estimated a as follows:

$EF_{ma,n} = (EF_1 + EF_2 + \ldots + EF_n) / n$ ($tN_2O/tHNO_3$)

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

To calculate the total emission reductions achieved in a campaign in formula below, 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 $EF_{ma,n} > EF_n$ then $EF_p = EF_{ma,n}$
If $EF_{ma,n} < EF_n$ then $EF_p = EF_n$

Where:

Variable	**Definition**
EF_n	Emission factor calculated for a specific project campaign ($tN_2O/tHNO_3$)
$EF_{ma,n}$	Moving average (ma) emission factor of after nth campaigns, including the current campaign ($tN_2O/tHNO_3$)
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 EF_x and EF_n) ($tN_2O/tHNO_3$)

Minimum project emission factor
A campaign-specific emissions factor will be used to cap any potential long-term trend towards decreasing N_2O emissions that may result from a potential built 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 a EF_n that is lower than EF_{min}, the calculation of the emission reductions for that particular campaign will used EF_{min} and not EF_n.

Where:

Variable	**Definition**
EF_{min}	Is equal to the lowest EF_n observed during the first 10 campaigns of the project crediting period ($N_2O/tHNO_3$)

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 baseline campaign can be used for the calculation of EF.

b. Shorter Project Campaign

In practice this means that, if the assumption that platinum deposits do have a reducing effect on N_2O emissions is correct, then an increasing adoption of EF_{min} instead of EF_n should be experienced as the project progresses through its crediting period.

If $CL_n < CL_{normal}$, EF_{BL} will be recalculated 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) from the calculation of EF_n.

Leakage

No leakage calculation is required.

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	$NCSG_{BC,l}$ N_2O concentration in the stack gas for particular line (l=1,2,3……8)	N_2O analyser Xentra 4900 QAL1 certified	mgN_2O/m^3 (converted from ppmV)	m	Every 2 seconds	24% (Lines 1-6) 36% (Lines 7-8) *To be defined exactly after the baseline measurements completion*	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.2	$VSG_{BC,l}$ Volume flow rate of the stack gas for particular line (l=1,2,3……8)	Gas volume flow meter Durag DF-L 200 QAL1 certified	m^3/h	m	Every 2 seconds	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	

B.3	$BE_{BC,l}$ Total N_2O for baseline campaign for particular line (l=1,2,3……8)	Calculation from measured data	tN_2O	c	At least once after baseline campaign	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.4	$OH_{BC,l}$ Operating hours for particular line (l=1,2,3……8)	Monitoring system	Hours	m	Daily, compiled for entire campaign	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.5	$NAP_{BC,l}$ Nitric acid (100% concentrated) over baseline campaign for particular line (l=1,2,3……8)	Production log	$tHNO_3$	m	Daily, compiled for entire campaign	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.6	TSG_l Temperature of stack gas for particular line (l=1,2,3……8)	Probe (part of gas volume flow meter)	°C	m	Every 2 seconds	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.7	PSG_l Pressure of stack gas for particular line (l=1,2,3……8)	Probe (part of gas volume flow meter)	Pa	m	Every 2 seconds	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	

B.8	$EF_{BL,l}$ Emission factor for baseline period for particular line (l=1,2,3……8)	Calculated from measured data	$tN_2O/tHNO_3$	c	At the end of the baseline campaign		Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.9	UNC Overall measurement uncertainty of the monitoring system	Calculation of the combined uncertainty of the applied monitoring equipment	%	c	Once after monitoring system is commissioned		Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.10	AFR_l Ammonia gas flow rate to the AOR for particular line (l=1,2,3……8)	Monitored	$kgNH_3/h$	m	Continuously	100%	Electronic and paper for at least 2 years	
B.11	$AFR_{max,l}$ Maximum ammonia flow rate for particular line (l=1,2,3……8)	Plant records	$kgNH_3/h$	m	Once	100%	Electronic and paper for at least 2 years	
B.12	$AIFR_l$ Ammonia to Air ratio for particular line (l=1,2,3……8)	Monitored	m^3/h	mc	Every hour	100%	Electronic and paper for at least 2 years	

B.13	$CL_{BL,l}$ Campaign length of baseline campaign for particular line (l=1,2,3……8)	Calculated from nitric acid production data	$tHNO_3$	c	After end of each campaign	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.14	$CL_{normal,l}$ Normal campaign length for particular line (l=1,2,3……8)	Calculated from nitric acid production data	$tHNO_3$	cm	Prior to end of baseline campaign		Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.15	$AIFR_{max,l}$ Maximum ammonia to air ratio for particular line (l=1,2,3……8)	Calculated	m^3/h	mcm	Once	100%	Electronic and paper for at least 2 years	
B.16	$OT_{h,l}$ Oxidation temperature for each hour for particular line (l=1,2,3……8)	Monitored	°C	m		100%	Electronic and paper for at least 2 years	
B.17	$OT_{normal,l}$ Normal operating temperature for particular line (l=1,2,3……8)	Monitored	°C	m	Once	100%	Electronic and paper for at least 2 years	

B.18	$OP_{h,l}$ Oxidation pressure for each hour for particular line (l=1,2,3……8)	Monitored	Pa	m		100%	Electronic and paper for at least 2 years	
B.19	$OP_{normal,l}$ Normal operating pressure for particular line (l=1,2,3……8)	Monitored	Pa	m	Once	100%	Electronic and paper for at least 2 years	
B.20	$GS_{normal,l}$ Normal gauze supplier for the operation condition campaigns for particular line (l=1,2,3……8)	Monitored		m		100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.21	$GS_{BL,l}$ Gauze supplier for baseline campaign for particular line (l=1,2,3……8)	Monitored		m	Once	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	

B.22	$GS_{project,l}$ Gauze supplier for the project campaigns for particular line (l=1,2,3……8)	Monitored		m	Each campaign	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.23	$GC_{normal,l}$ Gauze composition during the operation campaign for particular line (l=1,2,3……8)	Monitored		m	Each campaign	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.24	$GC_{BL,l}$ Gauze composition during baseline campaign for particular line (l=1,2,3……8)	Monitored		m	Once	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	
B.25	$GC_{project,l}$ Gauze composition during baseline campaign for particular line (l=1,2,3……8)	Monitored		m	Each campaign	100%	Electronic and paper for at least 2 years after end of the crediting period or last ERUs issuance	

B.26	EF_{reg} Emissions level set by incoming policies or regulations							

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

The baseline for all eight Achema nitric acid production lines shall be established separately through monitoring of N_2O concentration and gas flow volume in the stack in duration equal to one complete campaign prior to project implementation.

The schematic of the procedure is as follows:

1. 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 have been determined for the following parameters:

(i)	oxidation temperature;	880-910 °C
(ii)	oxidation pressure;	0-0.8 MPa
(iii)	ammonia gas flow rate,	max 7,500 Nm^3/h
(iv)	maximum ammonia to air ratio.	11.7%

The permitted range has been established using the procedures described below.

i. Oxidation temperature and pressure:

Process parameters monitored are the following:

OTh	Oxidation temperature for each hour (°C)
OPh	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 has been determined using the operating manual of the plant. Reason for choosing this approach was lack of historical data on these parameters. Prior to the JI project there was no necessity to store data on these parameters in previous campaigns.

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

Parameters monitored are the following:

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 limits for ammonia flow and ammonia to air ratio have been determined using operating manual of the plant. Reason for choosing this approach was lack of historical data on these parameters. Prior to the JI projects there was no necessity to store data on these parameters in previous campaigns.

Permitted ranges for pressure, temperature, ammonia flow rate and ammonia to air ratio determined are within the specifications of the facility.

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

N_2O concentration and gas volume flow are monitored on all Achema nitric acid production lines throughout the overlapped baseline campaign. The monitoring system installed complies with requirements of the European Norm 14181 (2004).

Monitoring system provides separate readings for N_2O concentration and gas flow volume for every hour of operation as an average of the measured values for the previous 60 minutes. Error readings (e.g. downtime or malfunction) and extreme values are eliminated.

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 applied to the complete data series of N_2O concentration as well as to the data series for gas volume flow. The statistical procedure is applied to data obtained after eliminating data measured for periods where the plant operated 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 product of the NCSG and VSG. The N_2O emissions per campaign are estimates product of N_2O emission per hour and the total number of complete
hours of operation of the campaign using the following equation:

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

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 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}) is then be reduced by the estimated percentage error as follows:

$$EF_{BL} = (BE_{BC} / NAP_{BC}) (1 – UNC/100) \ (tN_2O/tHNO_3)$$

where:

Variable	**Definition**
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}	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)
NAP_{BC}	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.

Since there are not in Lithuania any national or regional regulations for N_2O emissions, the resulting EFBL is used as the baseline emission factor.

Under certain circumstances, the operating conditions during the measurement period used to determine baseline N_2O emission factor may be outside the permitted range or limit corresponding to normal operating conditions. For instance, temperature, pressure, ammonia flow rate or ammonia to air ratio may be outside the permitted condition. Any N_2O baseline data that is measured during hours where the operating conditions are outside the permitted range are eliminated from the calculation of the baseline emissions factor.

In order to further ensure that operating conditions during the baseline campaign are representative of normal operating conditions, statistical tests will be performed to compare the average values of the permitted operating conditions with the average values obtained during the baseline measurement period.

Impact of regulations:

N_2O emissions regulations applicable to nitric acid plants in Lithuania (host country) are compared to the calculated baseline 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 $tN_2O/tHNO_3$) will be derived from the regulatory level. If the regulatory limit would be lower than the baseline factor determined for the project, the regulatory limit would serve as the new baseline factor, that is:

if $EF_{BL} > EFr_{eg}$, then the baseline N_2O emission factor shall be EF_{reg} for all calculations.

where:

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

Such EF_{reg} would be determined according to the nature of the regulation (e.g. in terms of absolute emission, by-product rate, concentration in stack gas), as described in the approved methodology AM0028/Version 04.1.

Control of applicable regulatory level of N_2O on Achema UKL-7 plant is responsibility of Chief of the Achema Environmental Centre.

The composition of the ammonia oxidation catalyst:

Composition of oxidation catalysts depends on latest technical knowledge of oxidation catalyst manufacturers as well as actual price of precious metals. Composition of all 8 oxidation catalysts installed during the baseline measurements were in line with compositions used in 5 previous campaigns. Same shall apply also to composition of oxidation catalysts to be used in subsequent project campaigns.

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

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 have been 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

The average historic campaign length (CL_{normal}) defined as the average campaign length for the historic campaigns used to define operating condition (the previous five campaigns), has been used as a cap on the length of the baseline campaign.

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} > CLnormal

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}.

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

D.1.2.1. Data to be collected in order to monitor emission reductions 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

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):

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

Due to nature of the project here is no leakage calculation required by the AM0034/Version 02.

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):

>>

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 emission reductions for the project activity over a specific campaign are determined by deducting the campaign-specific emission factor from the baseline emission factor and multiplying the result by the production output of 100% concentrated nitric acid over the campaign period and the GWP of N_2O:

$ER = (EFBL – EFP) * NAP *GWPN_2O$ (tCO_2e)

Where:

Variable	**Definition**
ER	Emission reductions of the project for the specific campaign (tCO_2e)

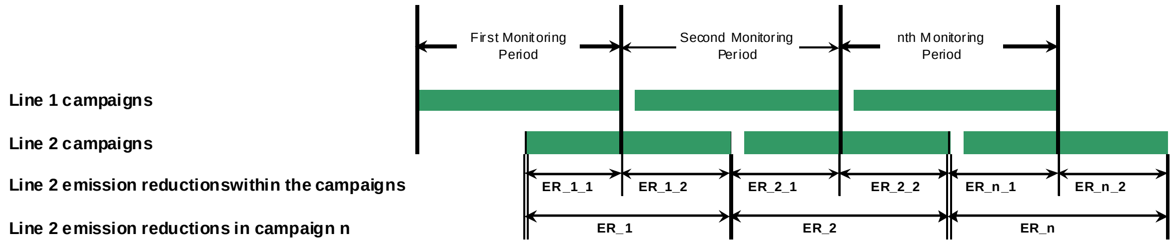
NAP	Nitric acid production for the project campaign ($tHNO_3$). The maximum value of NAP shall not exceed the design capacity.
EFBL	Baseline emissions factor ($tN_2O/tHNO_3$)
EFP	Emissions factor used to calculate the emissions from this particular campaign (i.e. the higher of $EF_{ma,n}$ and EF_n)

Nameplate capacity of Achema UKL-7 nitric acid plant is 350 metric tons of 100% nitric acid per line per day. For 8 UKL-7 lines it means aggregate daily capacity 2,800 tons of 100% nitric acid, i.e. total annual capacity 1,020,000 tons of 100% nitric acid. By nameplate (design) implies 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 nameplate, provided proper documentation of the projects is available (such as, but not limited to: properly dated engineering plans or blueprints, engineering, materials and/or equipment expenses, or third party construction services, etc.).

The AM0034 methodology is designed for nitric acid plants with no more than one line, whereas in Achema UKL-7 plant there are 8 nitric acid lines. Baseline emissions are measured separately for each line and a separate baseline factor is calculated for each line. Similarly, project emissions are recorded for each line. The number of emissions reductions of the project is the sum of emission reductions for each of the separate lines.

On the other hand the JI guidelines by date of completion of this document do not allow having more than one monitoring report for a particular period of time which makes it necessary to extend the AM0034 methodology especially when each particular line has its own campaign start and end dates. In order to be able to apply the AM0034 methodology on this project it was necessary to extend the methodology via use of conservative and sound engineering approach and in line with the JI guidelines, as illustrated below:

Table 3

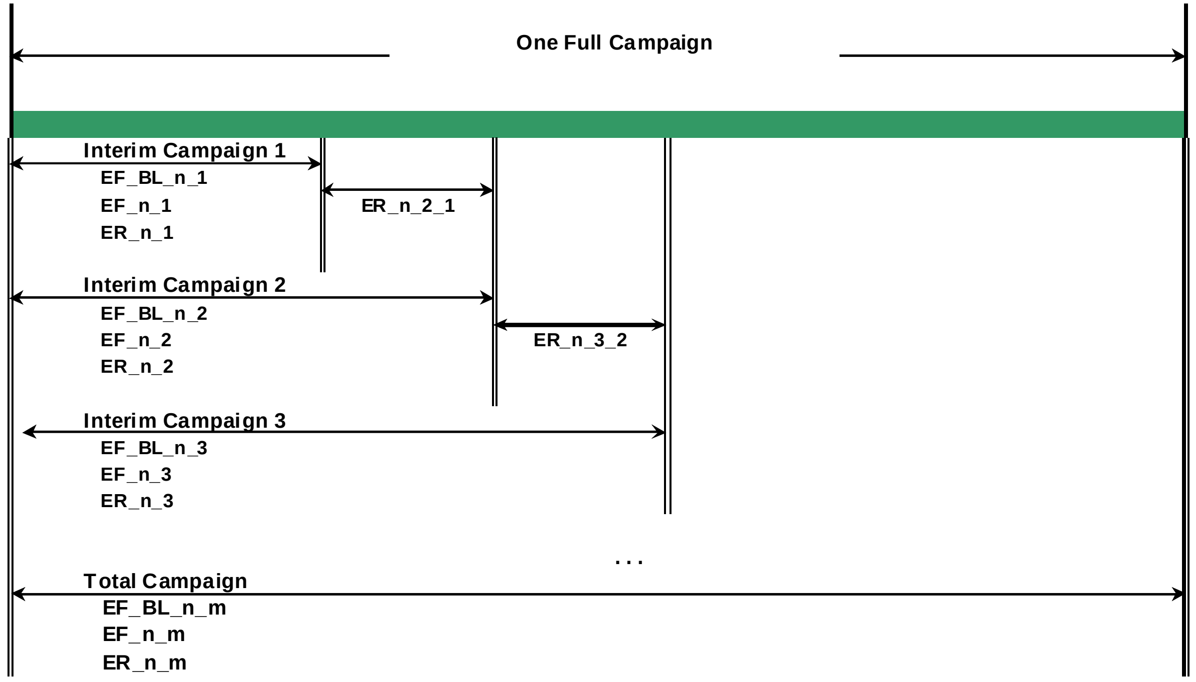


The methodology allows for having shorter project campaign than the normal campaign. For shorter campaigns the baseline emission factor is to be recalculated in a way that:

If $CL_n < CL_{normal}$, EF_{BL} will be recalculated by eliminating those N_2O values that were obtained during the production of tones of nitric acid beyond the CL_n (i.e. the last tonnes produced) from the calculation of EF_n.

Using this approach it is possible to break down each project campaign to interim campaigns. Each interim campaign that finishes at a later date fully overlaps the preceding interim campaigns as illustrated on the following chart:

Table 4



For each interim campaign the baseline emission factor, the project emission factor and the emission reduction can be calculated separately fully in line with the AM0034 methodology. At any point in time the methodology allows to define an interim campaign and calculate the emission reduction provided that the baseline emission factor was recalculated using the $CL_n < CL_{normal}$ rule.

This breaking down approach allows us to calculate the incremental emission reduction between two consecutive interim campaigns by the following formula:
ER_n_j_k = ER_n_j – ER_n_k

Where:

ER_n_j_k :	is the incremental emission reduction between interim campaigns j and k
ER_n_j:	is the total emission reduction in interim campaign j in line with the AM0034 methodology that fully overlaps with previous campaign k

ER_n_k: is the total emission reduction in interim campaign k in line with the AM0034 methodology

If the monitoring report is prepared in the middle of a campaign and for the same campaign emission reductions were already calculated in a preceding monitoring report, the emission reduction in the monitoring report period has to be calculated as follows:

ER_n_j_k = ER_n_j – ER_n_k

Where the end date of interim campaign k is set at the beginning of the monitoring period and j is set at the end of the monitoring period. Defining these dates and deducting the previous interim campaign emission reduction from the emission reduction of the latest interim campaig ensures that no emission reductions are counted more than once.

This approach is fully in line with the AM0034 methodology, it just provides a clarification or extension for plants where there are multiple lines. By using the $CL_n < CL_{normal}$ rule it guarantees that at any point in time no more emission reductions can be calculated or claimed than it is set by the AM0034 methodology, on the other hand it enables the project dealing with multiple lines by keeping the one monitoring report for a period and is fully in line with the JI guidelines.

As a result of this approach the Project will gain necessary flexibility in setting monitoring periods without any impact on conservativeness and sound engineering approach. There is no possibility this flexible approach would result into higher quantity of emission reductions claimed than by using basic approach, which is not applicable on specific projects such as this project. Example of calculation of the project emission reductions is illustrated in the table below:

Table 5

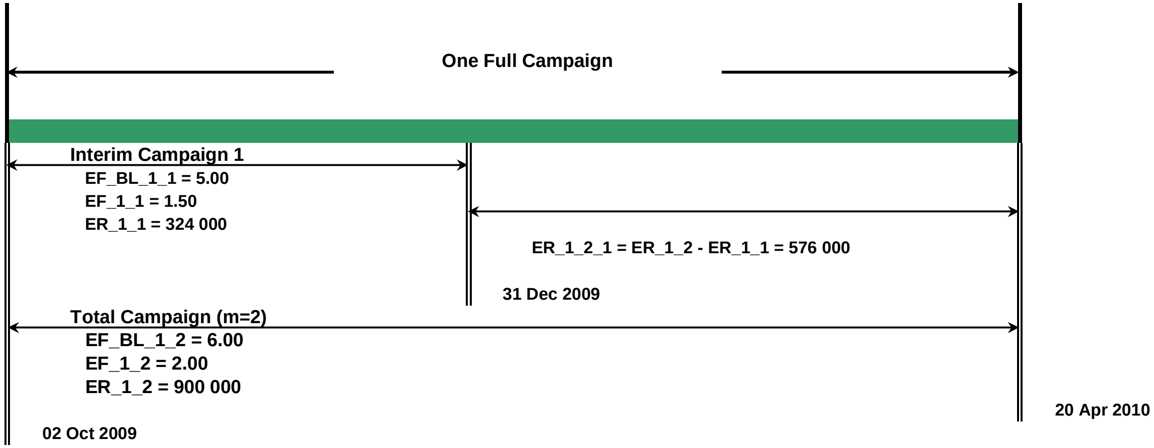
First Campaign Interim Campaign 1			
Start		02 Oct 2009	
End		31 Dec 2009	
Days		90	
Emission Factor Baseline	EF_BL_1_1	5.00	kgN2O/tHNO3
Emission Factor Project	EF_P_1_1	1.40	kgN2O/tHNO3
Nitric Acid Produced	NAP1_1	90,000	tHNO3
Emission Reduction	ER_1_1	324,000	tCO2e
First Campaign (m=2)			
Start		02 Oct 2009	
End		20 Apr 2010	
Days		200	
Emission Factor Baseline	EF_BL_1_2	6.00	kgN2O/tHNO3
Emission Factor Project	EF_P_1_2	1.50	kgN2O/tHNO3
Nitric Acid Produced	NAP_1_2	200,000	tHNO3
Emission Reduction	**ER_1_2**	**900,000**	**tCO2e**
Monitoring Reports			
First Monitoring Report			
Emission Reduction (First Campaign Interim Campaign 1)	ER_1_1	324,000	tCO2e
Second Monitoring Report			
Total First Campaign Emission Reduction	ER_1_2	900,000	tCO2e
Less Emission Reduction Calimed in the First Report	ER_1_1	(324,000)	tCO2e
Emission Reduction	ER_1_2-ER_1_1	576,000	tCO2e
Total Emission Reduction Claimed on the First Campaign		**900,000**	**tCO2e**

This table illustrates calculation of emission reductions generated during campaign starting e.g. in October 2009 and continuing until April 2010. First part of the campaign from October 2009 until December 2009 falls under the first monitoring period. For this monitoring period total quantity of N_2O emissions will be calculated and emission reductions will be calculated using the baseline emission factor corresponding to the nitric acid production during the project campaign from October 2009 through December 2009. This is fully in line with the AM0034 methodology.

Second part of the campaign from January 2009 through April 2010 falls under second monitoring period and will be calculated taking into account total quantity of N_2O emissions from October 2009 until April 2010 but deducting the emission reductions that have been already counted. Emission reductions will be calculated using the baseline emission factor corresponding to the nitric acid production during the project campaign from October 2009 through April 2010 minus quantity of emission reductions already verified during the first monitoring period. This way project can gain necessary flexibility in setting relevant monitoring periods without compromising conservative approach in calculation of emission reductions, because total quantity of emission reductions will be exactly the same as using the AM0034 basic one line approach.

This approach is illustrated in the diagram below:

Table 6



Project can use for calculation and verification of emission reductions generated from nitric acid lines of the UKl-7 nitric acid plant also approach approved in the Clarification regarding overlapping monitoring periods under the verification procedure the Joint Implementation Supervisory Committee Version 01.

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:

Since N_2O does not have any negative impact on an environment in vicinity of its point of emitting and it does not have any significant and attributable impact on population living in the plant’s vicinity, it is not required to carry out the environmental impact study.

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.**
P.1, B.1 $NCSG_{BC,l}$ N_2O concentration in the stack gas for particular line	Low	N_2O analyser XENTRA 4900 (Servomex manufacturer) QAL1 certified, QAL2 test carried, QAL3 procedures defines and carried out at the plant

P.2, B.2 $VSG_{BC,l}$ Volume flow rate of the stack gas for particular line	Low	Gas volume flow meter D-FL-200 (Durag manufacturer) QAL1 certified, QAL2 test carried, QAL3 procedures defines and carried out at the plant
P.6, B.6 TSG_l Temperature of stack gas for particular line	Low	Regular calibration and control according to existing measurement requirements
P.7, B.7 PSG_l Pressure of stack gas for particular line	Low	Regular calibration and control according to existing measurement requirements
B.9 UNC Overall measurement uncertainty of the monitoring system	Low	Regular calibration and control according to existing measurement requirements
B.10 $AIFR_l$ Ammonia gas flow rate to the AOR for particular line	Low	Regular calibration and control according to existing measurement requirements
B.16 $OT_{h,l}$ Oxidation temperature for each hour for particular line	Low	Regular calibration and control according to existing measurement requirements

B.18 $OP_{h,l}$ Oxidation pressure for each hour for particular line	Low	Regular calibration and control according to existing measurement requirements

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

>>

“Sistematika”a subsidiary of SC”Achema” is in charge of operation and maintenance of the N_2O monitoring system. The Nitric acid production department is responsible for the N_2O monitoring and for reporting faults in the operation of the monitoring system to “Sistematika”.Perfomance of monitoring system will be supervised by plant operators and the technical support will be provided by the directly responsible automation engineer.

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

>>

Organisation:	Stock Company “Achema”
Street/P.O.Box:	
Building:	
City:	Jonava
State/Region:	Jonalaukis village, Rukla county, Jonava region municipality
Postal code:	Lt-55550
Country:	Lithuania
Phone:	+370 349 56242
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E-mail:	sekretoriatas@achema.com
URL:	www.achema.com
Represented by:	Ramūnas Pilsudskas
Title:	Nitric acid plant deputy chief
Salutation:	Mr
Last name:	Pilsudskas

Middle name:	-
First name:	Ramūnas
Department:	-
Phone (direct):	+370 349 56503
Fax (direct):	
Mobile:	+370 682 41241
Personal e-mail:	pilsudskas@achema .com

SECTION E. Estimation of greenhouse gas emission reductions

E.1. Estimated project emissions:

449,313 tCO_2e/year

It should be noted that the level of emissions of the project is a function of the amount of nitric acid produced by the plant. The amount of nitric acid produced by the plant is a function of demand for relevant Achema's products. This cannot be predicted today with certainty. The figures used above are a best estimate and are illustrative. The actual level of project emissions may be higher or lower than the figures given above.

E.2. Estimated leakage:

There is no leakage.

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

449,313 tCO_2e/year

E.4. Estimated baseline emissions:

1,497,710 tCO_2e/year

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

1,048,397 tCO_2e/year

This table shows an estimate of future circumstances. As explained above the actual number of emission reductions may be higher or lower than that shown in the table. It is important to note, that due to the secondary catalysts installation time schedule emission reductions in 2008 will be lower than in following project operation years.

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

Year	**Estimated project emissions in tCO_2e/year**	**Estimated leakage in tCO_2e/year**	**Estimated baseline emissions in tCO_2e/year**	**Estimated emission reductions in tCO_2e/year**
2008	230,980	0	769,933	538,953
2009	449,313	0	1,497,710	1,048,397
2010	449,313	0	1,497,710	1,048,397
2011	449,313	0	1,497,710	1,048,397
2012	449,313	0	1,497,710	1,048,397
Total in tCO_2e/year	**2,028,232**	**0**	**6,760,773**	**4,732,541**

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 has no material adverse environmental impacts. The project's sole material environmental impact is the reduction in emissions of nitrous oxide. Immaterial, indirect, environmental impacts of the project are the environmental impact of the production and transport of steel alloy and catalyst material. However, these are considered immaterial, and are provided by suppliers which are subject to European Union environmental legislation.

The project does not require the preparation of an environmental impact assessment.

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:

n/a

SECTION G. Stakeholders' comments

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

The PDD was made publicly available on the JI website and Parties, stakeholders and NGOs were through the JI website invited to provide comments during a 30 days period from 23 October 2007 to 21 November 2007 under ref. no. 0089.

One comment was received from Dr. Karsten Karschunke regarding analysis of the legal requirements for nitric acid plants in Lithuania taking EU Law into account in the Determination report.

Determination report issued by DNV has elaborated on this issue as stated in the Determination report.

Annex 1

CONTACT INFORMATION ON PROJECT PARTICIPANTS

Organisation:	Stock Company “Achema”
Street/P.O.Box:	
Building:	
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E-mail:	sekretoriatas@achema.com
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Represented by:	
Title:	Head of Innovation Centre
Salutation:	Mr
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Annex 2

BASELINE INFORMATION

Table 7

Main assumptions	Line 1	Line 2	Line 3	Line 4	Line 5	Line 6	Line 7	Line 8	TOTAL	
Plate Capacity	350	350	350	350	350	350	350	350	2,800	t/Day
Average Production	5,900	5,900	5,900	5,900	5,900	5,900	5,900	5,900	47,200	t/Day
Annual Production	86,042	86,042	86,042	86,042	86,042	86,042	86,042	86,042	688,333	t/year
N2O Concentration	1,530	1,067	842	1,233	942	1,040	1,222	788	1,083	ppmv
N2O Emission	9.92	6.92	5.46	7.99	6.10	6.74	7.92	5.11	7.02	kg/t
Annual N2O Emission	853,292	595,044	469,490	687,460	525,249	579,784	681,482	439,521	4,831,323	kg/year
Annual N2O Emission	264,521	184,464	145,542	213,113	162,827	179,733	211,259	136,252	1,497,710	tCO2e/year
Emission Reduction Factor	70%	70%	70%	70%	70%	70%	70%	70%	70%	
Emission Reduction	**185,164**	**129,125**	**101,879**	**149,179**	**113,979**	**125,813**	**147,882**	**95,376**	**1,048,397**	**tCO2e/year**

Table above presents the main assumptions and the calculations method used when projecting the emission reductions contained in this PDD.

Assumptions have been derived from technical literature, plant technical parameters, partial measurements and information provided by catalyst suppliers.

It important to point out that assumptions are estimates only, therefore, the final baseline information will be available only after completion of baseline measurements and submission of relevant monitoring reports.

Annex 3

MONITORING PLAN

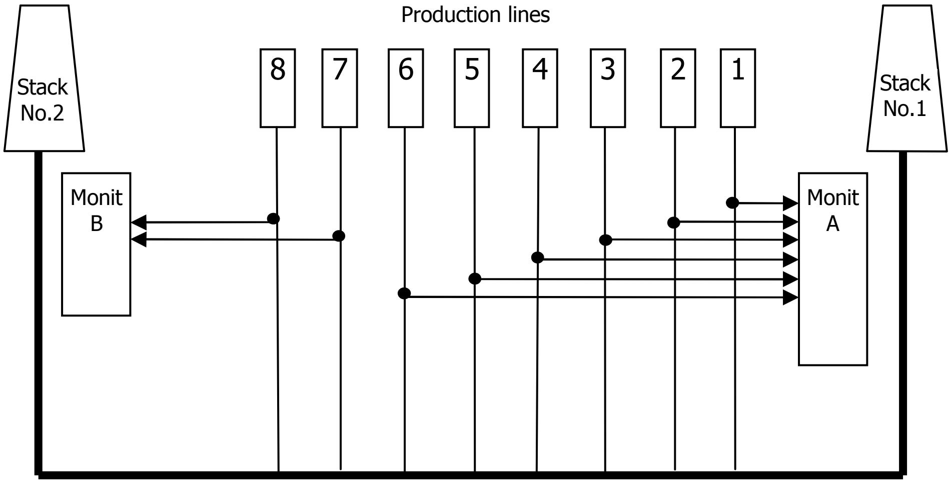
PURPOSE OF THE MONITORING PLAN

The purpose of the monitoring plan is to describe the system used to monitor emissions of N_2O from the plant in such a way that is compliant with the prescriptions of the AM0034/Version 02.

PLANT DESCRIPTION

The UKL-7 nitric acid plant comprises 8 production lines numbered from 1 through 8, each with its own burner, absorption column and expansion turbine. Each production line represents a separate nitric acid production unit independent from each other. The tail gasses from each line are after expansion turbines led to a common stack bus and vented through two interconnected stacks.

Diagram 5



Primary catalyst is changed at different times thus it is necessary to measure the emissions from each line individually. This means that eight separate sets of monitoring equipment are installed to measure tail gas flow, nitric acid production, nitric acid concentration, and the operating conditions. N_2O concentration in the tail gas is measured by 3 switched concentration meters.

MONITORING SYSTEM ARCHITECTURE

Methodology AM0034/Version 02 requires installation of an N_2O monitoring system that includes both a gas volume flow meter to determine the tail gas mass volume flow and an infrared gas analyser to determine the concentration of N_2O.

But tail gas N_2O concentration meter and tail gas volume flow meter alone are not sufficient for a JI project purposes. In order of being able to calculate the baseline emission factor expressed as tonnage of N_2O in t CO_2e per 1 tonne of HNO_3 (100%), it is necessary to include also HNO_3 measurement, and in order of being able to document normal operating conditions it is necessary to include also operating conditions measurement.

Because of this we use the term Monitoring System (MS) to describe entire monitoring system directly and indirectly used for the JI purposes, while Automated Measurement System (AMS) covers only N_2O emissions and tail gas mass volume part of the MS.

Monitoring System (MS) for purpose of this monitoring plan means:

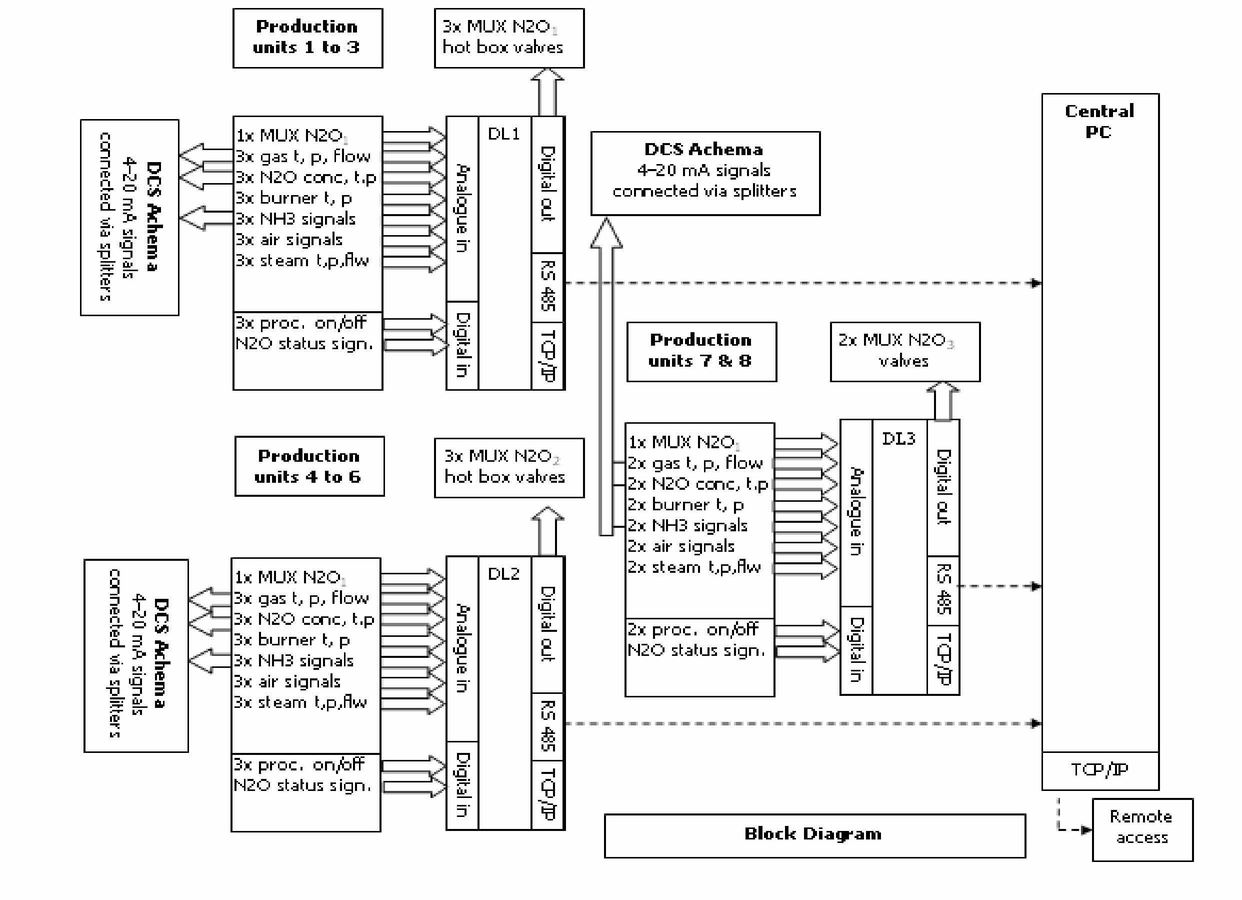
4. monitoring system measuring operational conditions;
    a. Ammonia volume flow
    b. Ammonia temperature
    c. Ammonia pressure
    d. Primary air volume flow
    e. Primary air temperature
    f. Primary air pressure
    g. Oxidation temperature
    h. Oxidation pressure

5. nitric acid 100% concentrate production;
    a. Nitric acid concentration
    b. Nitric acid flow
    c. Nitric acid temperature

6. and newly installed measurement devices for measurement of N_2O concentration and tail gas flow, temperature and pressure (AMS)
    a. N_2O concentration in the stack
    b. Stack volume flow rate
    c. Stack gas temperature
    d. Stack gas pressure

Incorporation of the AMS into the MS by interfacing already existing and newly installed measurement devices is documented by the diagram below.

Diagram 6



N_2O automated measurement system

Main purpose of the N_2O automated measurement system (AMS) is to measure total mass of N_2O emitted during particular campaigns (both baseline and project). In order of calculation of total mass of N_2O emitted during particular campaign it is necessary to measure on an extractive basis the N_2O concentration in a tail gas and on a non-extractive basis tail gas flow, pressure and temperature.

N_2O concentration

N_2O concentration is measured by extractive measurement system. Tail gas samples are taken from respective tail gas ducts at sampling points located after expansion turbines and transported by heated sample lines to the Monitoring room A located next to the main production hall. This applies to 2 concentration meters measuring lines 1-3 and lines 4-6. Lines 7-8 are measured by third concentration meter located at the other side of the production hall (Monitoring room B) physically closer to respective production lines 7 and 8.

Tail gas samples are filtered and conditioned in the condensation dryer (4°C), so N_2O concentration is measured on a dry basis. Correction of dry basis ppmV value to real wet tail gas conditions based on steam flow injected into the system is part of both - the project emissions calculations and baseline emission factor calculations.

N_2O concentration is measured by concentration infrared absorption principle meters Xentra 4900 using GFX monitoring technology.

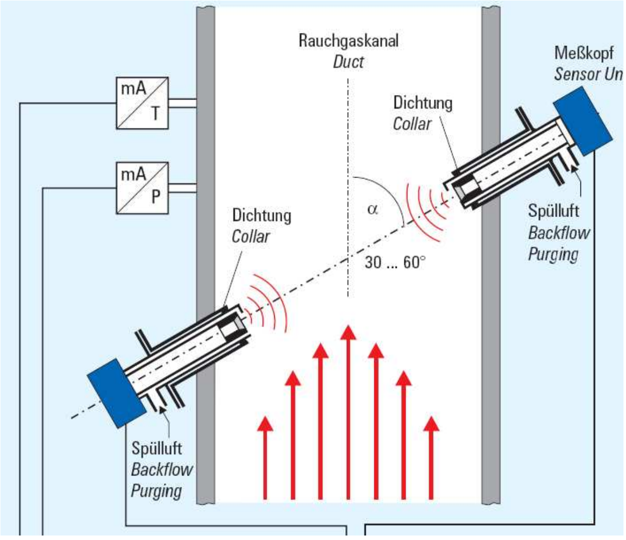
Recently there are 8 production lines. N_2O concentration is measured by 3 concentration meters on a switched basis. Tail gas samples are automatically switched. Under-sampling uncertainty is part of both - the project emissions calculations and baseline emission factor calculations.

N_2O concentration measured data are sent from the concentration meter on a 2 sec basis in a form of 4-20mA signal to the datalogger and processed further.

Tail gas flow, pressure and temperature

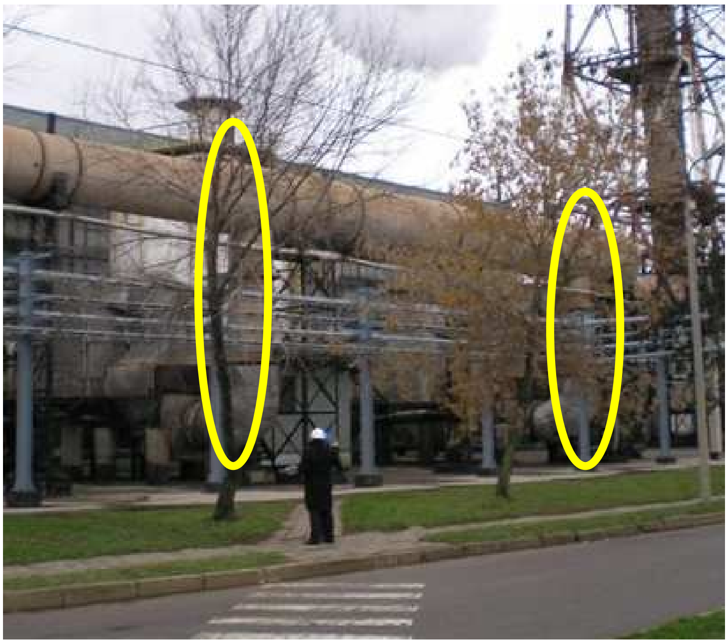
Tail gas flow is measured by ultrasonic Durag DF-L 200 flowmeters based on ultrasonic pulse fly time across the entire duct cross-section.

Picture 6



The tail gas ducts do not allow any optimum location to perform the flow monitoring. The only possible location is the quite short vertical tube behind the 90° "knee".

Picture 7



Since the flow is not really laminar, a classical Pitot tube one point solution wouldn't allow good results. The ultrasonic system is under these conditions superior to differential pressure. Cross duct monitoring is more accurate than a couple of discrete point averaged pressure.

Tail gas flow, pressure and temperature measured data are sent from the flow meter on a 2 sec basis in a form of 4-20mA signal to the datalogger and processed further.

EN14181 compliance

As required by the AM0034/Version 02 methodology the N_2O automated measurement system (AMS) complies with requirements of the technical norm EN14181. N_2O AMS consists from the N_2O concentration meter and integrated flowmeter (F, T, P). Both measurement devices are QAL1 certified (concentration meter for the N_2O measurand specifically) and after full commissioning of the monitoring system there was the QAL2 test carried out by an independent laboratory Airtec certified according to ISO17025.

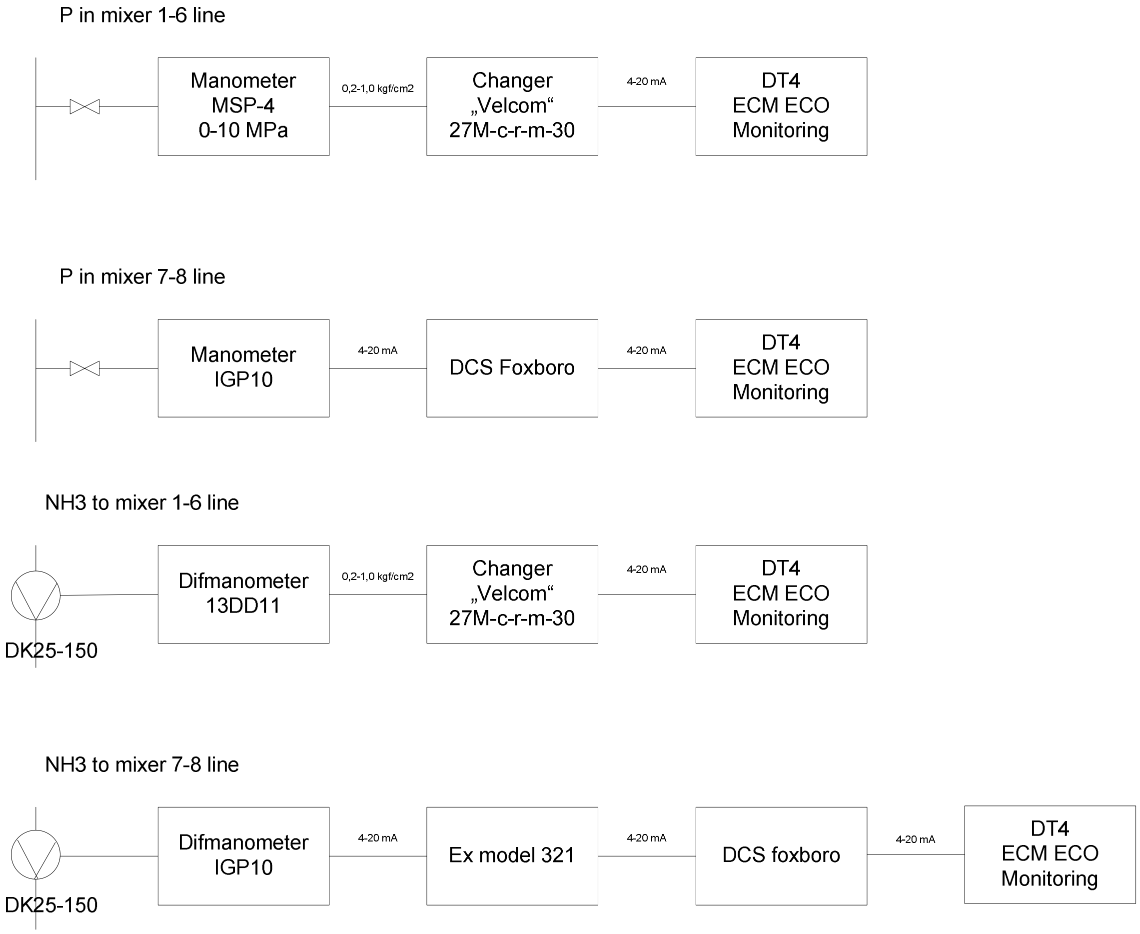
Operating conditions

For purpose of the baseline emissions factor setting it is necessary to monitor and report operating conditions in all 8 burners. Namely:

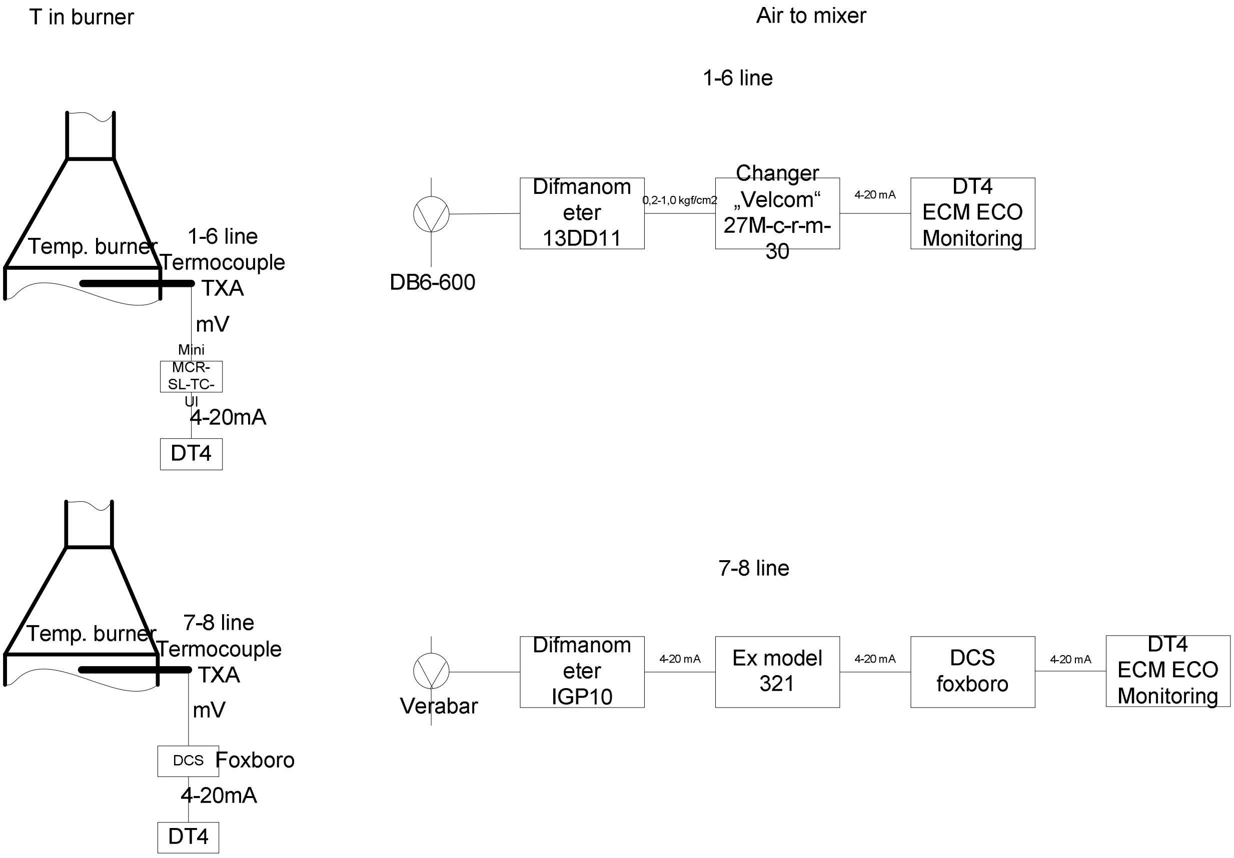
- Ammonia flow
- Ammonia temperature
- Ammonia pressure
- Primary air flow
- Primary air temperature
- Primary air pressure
- Oxidation temperature
- Oxidation pressure

All these parameters are measured by the plant monitoring system as presented on diagrams below:

Picture 8


P in mixer 1-6 line
Manometer MSP-4 0-10 MPa
0,2-1,0 kgf/cm2
Changer „Velcom“ 27M-c-r-m-30
4-20 mA
DT4 ECM ECO Monitoring
P in mixer 7-8 line
Manometer IGP10
4-20 mA
DCS Foxboro
4-20 mA
DT4 ECM ECO Monitoring
NH3 to mixer 1-6 line
Difmanometer 13DD11
0,2-1,0 kgf/cm2
Changer „Velcom“ 27M-c-r-m-30
4-20 mA
DT4 ECM ECO Monitoring
DK25-150
NH3 to mixer 7-8 line
Difmanometer IGP10
4-20 mA
Ex model 321
4-20 mA
DCS foxboro
4-20 mA
DT4 ECM ECO Monitoring
DK25-150

Picture 9



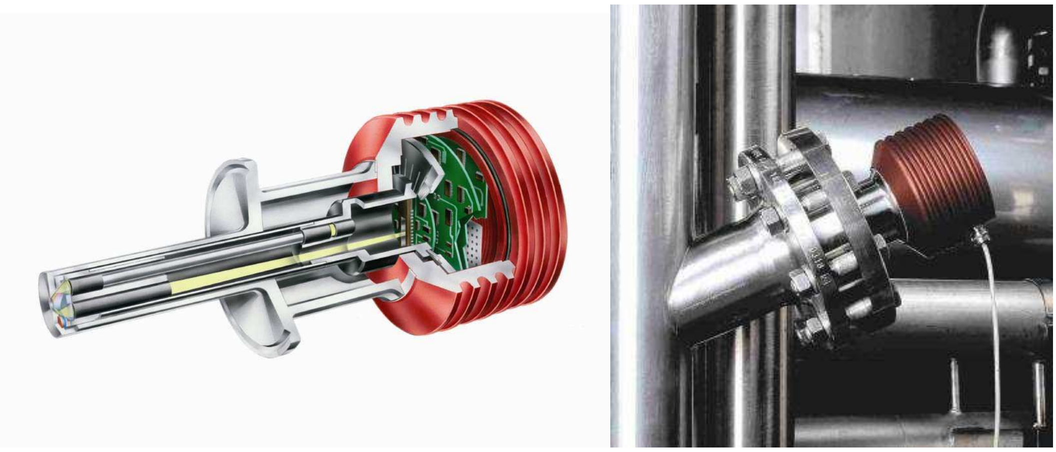
Signals obtained from these measurement devices from production lines 1-6 are converted from pneumatic to 4-20mA analog signals. Operating conditions measurement devices installed in production lines 7-8 provide the 4-20mA signals which are digitalized and provided to the monitoring system dataloggers, which process them further. Maintenance procedures for the ammonia oxidation parameters follow the existing procedures for the operation of the nitric acid plant.

<u>Nitric acid production</u>

Nitric acid concentration is based on two components: nitric acid and water. Standard monitoring method is on-line refractometry. Measurement of nitric acid (100%) mass volume production per campaign is necessary for calculation of the baseline emissions factor. Nitric acid concentration on all 8 lines is measured by K-Patents PR-23-GP refractometers.

This analyzer is applying a prism to “return” a generated optical beam back to an LCD detector.

Picture 10



The detector is measuring refraction of monitored liquid based on known refraction of water and nitric acid. The instrument is calibrated for percent concentration of nitric acid. The analyzer is mounted on DIN-flange 2656, PN25 DN80. The optical prism does not require cleaning.

PR-23-GP characteristics:

- Measuring RI is a direct concentration measurement principle. No need to rely or convert magnitudes.
- Digital instrument – no calibration drift
- As it is a robust instrument it is maintenance free
- Dual connectivity if the installation positions allow.
- On-line data logging, through Ethernet, on whichever web browser.
- No influence by bubbles or particles. It is very common that air enters the process pipeline and still the refractometer measures accurately.

Nitric acid concentration data are in an analog 4-20mA format provided to dataloggers which process these signals further.

In order of being able to calculate total mass volume of nitric acid 100% concentrate produced during the baseline campaign it is necessary to monitor also nitric acid flow and temperature. Measurement of pressure is not necessary for determination of the nitric acid mass volume flow, because nitric acid is in form of liquid and as such it has stabile pressure characteristic.

Signals obtained from the nitric acid flow and temperature measurement devices from production lines 1-6 are converted from pneumatic to 4-20mA analog signals. Nitric acid flow and temperature measurement devices installed in production lines 7-8 provide the 4-20mA signals which are digitalized and provided to the monitoring system dataloggers, which process them further.

QAL3 Procedures

Regular QAL3 maintenance procedures are described in the Annex 1 A-245-09 to the plant operation manual “Instrukcija”.