MONITORING REPORT FORM (F-CDM-MR)
Version 02.0

MONITORING REPORT

Title of the project activity	PROJECT FOR THE CATALYTIC REDUCTION OF N2O EMISSIONS WITH A SECONDARY CATALYST INSIDE THE AMMONIA REACTOR OF THE NO. 9 NITRIC ACID PLANT AT AFRICAN EXPLOSIVES LTD (“AEL”), SOUTH AFRICA
Reference number of the project activity	1171
Version number of the monitoring report	04
Completion date of the monitoring report	17/10/2012
Registration date of the project activity	05/11/2007
Monitoring period number and duration of this monitoring period	- Number 6 - 15/07/2011 – 11/03/2012, 241 days
Project participant(s)	- African Explosives Ltd - N.serve Environmental Services GmbH
Host Party(ies)	South Africa
Sectoral scope(s) and applied methodology(ies)	- Sectoral scope: Chemical industries (5) - AM0034 (Version 2)
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	77,106 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	55,976 tCO_2e

SECTION A. Description of project activity
A.1. Purpose and general description of project activity
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Purpose of the project activity and measures taken to reduce GHG emissions

The sole purpose of the project activity is to significantly reduce former levels of N_2O emissions from the production of nitric acid at AEL's nitric acid plant No. 9 ("AEL-9") in Modderfontein, South Africa, by implementation of a secondary N_2O abatement catalyst.

Brief description of the installed technology and equipments

The employed secondary N_2O abatement catalyst technology is supplied by Johnson Matthey PLC. Continuous monitoring of emission reductions is assured by an Automated Measuring System (AMS), consisting of stack gas volume flow meter, N_2O Analyser, and respective data logging facilities. The AMS as well as its installation complies with the requirements of the European Standard EN 14181 as required by the methodology.

Relevant dates for the project activity

Registration Date:	05/11/2007
Installation of AMS:	The N_2O Analyser was installed in May 2007. The stack gas flow meter was installed in June 2006

Baseline Campaign:	"H15" [1] : 05/09/2007 – 06/11/2007
Installation of secondary catalyst:	09/11/2007
Starting Date of Project Activity:	09/11/2007

Project Campaigns completed prior to current monitoring period:

Project Campaigns:	1. Campaign	PC1 - 09/11/2007-09/02/2008
	2. Campaign	PC2 -19/02/2008-12/06/2008
	3. Campaign	PC3 - 08/07/2008-28/07/2008
	4. Campaign	PC4 - 25/02/2009-04/08/2009
	5. Campaign	PC5 - 05/08/2009-01/11/2009
	6. Campaign	PC6 - 30/11/2009-07/03/2010
	7. Campaign	PC7 - 08/04/2010-01/07/2010
	8. Campaign	PC8 - 21/09/2010-10/02/2011
	9. Campaign	PC9 - 11/02/2011-15/04/2011
	10. Campaign	PC10 - 20/04/2011-14/07/2011

Project Campaigns covered by current Monitoring/Verification Period:

	11. Campaign	PC11 – 26/07/2011-18/12/2011
	12. Campaign	PC12 – 04/01/2012-11/03/2012

Total emission reductions achieved in this monitoring period

The total amount of emission reductions achieved in this monitoring period is 55,976 t CO_2e.

[1] H15 refers to AEL internal designation of the different production campaigns

A.2. Location of project activity

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Host Party: South Africa
Region/State/Province: Gauteng / Modderfontain
City/Town/Community: City of Johannesburg
Physical/Geographical location: 26°05'26'' South, 28°10'17'' East

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
South Africa (host)	African Explosives Ltd ("AEL")	No
United Kingdom of Great Britain and Northern Ireland	N.serve Environmental Services GmbH ("N.serve")	No
Switzerland	N.serve Environmental Services GmbH, African Explosives Ltd	No

A.4. Reference of applied methodology

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a) AM0034 "Catalytic reduction of N2O inside the ammonia burner of nitric acid plants" Version 2

   For the baseline selection: AM0028 "Catalytic N2O destruction in the tail gas of Nitric Acid or Caprolactam Production Plants" Version 03

b) "Tool for the demonstration and assessment of additionality" Version 02

A.5. Crediting period of project activity

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Type: Non-renewable crediting period,
Start date: 05/11/2007
Length: 10 years 0 months

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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Description of the installed technology, technical processes and equipment

The project activity entails the installation and implementation of the following technical equipment and quality measures:

1.) secondary N_2O abatement technology
2.) Automated Monitoring System (AMS) for continuous N_2O measurement which is fully in compliance with European Standard EN 14181 (see Section C for more detail)
3.) training of local staff on installation, operation and maintenance of catalyst and monitoring equipment, etc. as well as implementation of quality check and quality assurance measures (see Section C for more detail)

Catalyst Technology

AEL has contracted with Johnson Matthey PLC who exclusively markets a secondary catalyst technology that has been developed by YARA International ASA (Norway). AEL installed the YARA 58 Y 1®

catalyst system consisting of an additional base metal catalyst that is installed below the standard precious metal gauze pack.

The catalyst has been tried and tested in a number of nitric acid plants in Europe. The abatement efficiency has been shown to be better than 70 - 90% in the following reaction:

$2N_2O \rightarrow 2N_2 + O_2$

No contamination of the nitric acid with Cobalt or any of the other catalyst materials has been observed.

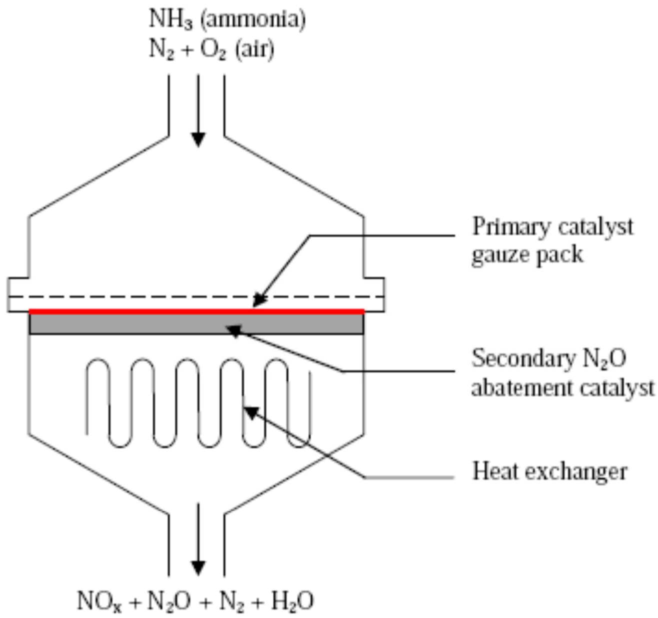
The catalyst does not require additional heat or other energy over and above the temperature that is present inside the Ammonia Oxidation Reactor anyway. There are no additional greenhouse gases or other emissions generated by the reactions on at the N_2O abatement catalyst.

This technology has been implemented inside the AEL-9 ammonia oxidation reactor.

The precious metal gauze pack – i.e. the primary catalyst required for the actual production of nitric acid – has been supplied to AEL by Heraeus Ltd. for a number of years. The precious metal composition of that gauze pack remains unchanged during the crediting period of the project.

N_2O abatement catalyst installation

The secondary catalyst itself is easily installable during a routine plant shut-down and gauze change. The pellets are poured into the support basket / heat shield arrangement and raked level. The gauze pack is then installed above this bed using the support mechanism provided by the heat shield.



AEL's nitric acid plant No.9 operates at a pressure of around 8.6 - 9 bars inside the ammonia oxidation reactor.

Information on the implementation and actual operation of the project activity, including relevant dates

The determination of the permitted operating conditions for operating temperature, operating pressure, maximum ammonia flow rate, maximum ammonia to air ratio normal gauze supplier and normal gauze composition was undertaken by the validating DOE (as it was clarified by the CDM EB in EB31 meeting that either validating or verifying DOE could undertake the task of determination of the permitted operating conditions). However, the normal campaign length as well as the determination of the baseline emission factor was in the scope of the verifying DOE. These parameters were determined and verified within the course of the first verification. The baseline campaign that was operated from 05/09/2007 until 06/11/2007.

The secondary catalyst was installed on the 09/11/2007, which is the starting date of the project activity. The project got registered by UNFCCC on the 05/11/2007, which is the starting date of the crediting period.

For a more detailed list of secondary catalyst installation, AMS installation, continued operating periods and other relevant dates for the project activity, see Section A.1, paragraph "*Relevant dates for the project activity*" above.

The events or situations that occurred during the monitoring period that may impact the applicability of the applied methodology

As to the characteristics of this specific project type certain production related events and incidents may affect the performance of the project or influence the monitoring of emission reductions in addition to possible failure of the installed monitoring equipment. The below table and lists demonstrates all relevant events and incidents related to production and/or emission monitoring which have occurred during actual operation within this specific monitoring period, as well as the measures taken for addressing any resulting problems and issues.

#	**Start of the event**	**End of the event**	**Campaign**		**Short description**
			AEL designation	Project campaign	
	15/07/2011	26/07/2011			Plant downtime for maintenance
1	26/07/2011 16:00		H31	PC11	New campaign start with fresh primary gauze, start of project campaign 11
2	29/07/2011 04:00	29/07/2011 12:00	H31	PC11	Plant offline due to compressor trip
3	01/08/2011 12:00	03/08/2011 21:00	H31	PC11	Plant offline due to capacity control
4	15/08/2011 10:00	29/08/2011 09:00	H31	PC11	AMS problem with sample gas pump – NCSG values eliminated
5	20/09/2011 03:00	10/10/2011 07:00	H31	PC11	Plant offline due to low ammonia stock.
6	11/10/2011 13:00	12/10/2011 05:00	H31	PC11	Plant tripped on low steam pressure
7	13/10/2011 01:00	13/10/2011 05:00	H31	PC11	Plant tripped on low steam pressure and LP compressor surge.
8	14/10/2011 18:00	15/10/2011 15:00	H31	PC11	Plant tripped on low steam pressure and LP compressor surge.

9	22/10/2011 05:00	25/10/2011 00:00	H31	PC11	Tripped due to low instrument air.
10	29/10/2011 18:00	07/11/2011 13:00	H31	PC11	Offline due to low ammonia stock.
11	15/11/2011 07:00	15/11/2011 11:00	H31	PC11	Trip due to low steam
12	22/11/2011 13:00	28/11/2011 04:00	H31	PC11	Plant offline due to low ammonia stock
13	07/12/2011 23:00	08/12/2011 18:00	H31	PC11	Plant offline due to low ammonia stock
14	18/12/2011 01:00		H31	PC11	End of campaign and primary gauze change
15	04/01/2012 12:00		H32	PC12	New campaign start with fresh primary gauze, start of project campaign 12
16	17/01/2012 18:00	22/01/2012 23:00	H32	PC12	Plant tripped due to problems with steam supply
17	30/01/2012 07:00	09/02/2012 04:00	H32	PC12	Plant offline due to capacity control.
18	09/02/2012 05:00	09/02/2012 14:00	H32	PC12	AMS problem with condensate pump – NCSG values eliminated
19	14/02/2012 21:00	15/02/2012 01:00	H32	PC12	Plant tripped due to LP steam pressure drop
20	27/02/2012 12:00	03/03/2012 18:00	H32	PC12	Plant offline due to capacity control.
21	06/03/2012 04:00	08/03/2012 19:00	H32	PC12	Prepare for maintence
22	11/03/2012 13:00		H32	PC12	End of campaign and primary gauze change

According to the methodology, error readings and extreme values are to be eliminated from the raw data before the calculation of emission reductions. For the period 15/08/2011 10:00 hours - 29/08/2011 09:00 hours the sample gas was diluted due to a badly connected tube to the sampling gas pump. It was observed that on 09/02/2012 (from 05:00 to 14:00 hours) the N_2O analyser was not showing the correct reading due to problems with the condensate pump. The NCSG values for these periods were eliminated before the calculation of emission reductions.

The concentration of the certified gas cylinder installed on 10/10/2011 is 1,080 ppm, while the span check considered the nominal concentration of 1,000 ppm for reporting purposes. A correction factor of 1.08 was applied to all NCSG values from 10/10/2011 to 21/11/2011 (the period when the analyser was calibrated with the wrong span gas concentration value of 1.000 ppm instead of 1,080 ppm).

None of the events listed above and no other events or incidents of any relevance in regard to impacting the applicability of the methodology occurred during this monitoring period.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

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No temporary deviations from the registered monitoring plan or applied methodology have been applied during this monitoring period.

B.2.2. Corrections

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No corrections to project information or parameters fixed at validation have been approved during this monitoring period or submitted with this monitoring report.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

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No permanent changes from the registered monitoring plan or applied methodologies have been approved during this monitoring period or submitted with this monitoring report.

B.2.4. Changes to project design of registered project activity

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No changes to project design of the project activity have been approved during this monitoring period or submitted with this monitoring report.

B.2.5. Changes to start date of crediting period

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No changes to the start date of the crediting period have been approved during this monitoring period or submitted with this monitoring report.

B.2.6. Types of changes specific to afforestation or reforestation project activity

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Not applicable.

SECTION C. Description of monitoring system

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1. General Description of the AMS

A complete Automated Monitoring System (AMS) to monitor the mass emissions of N_2O at the stack of AELs No. 9 nitric acid plant was installed and has been operated since May 2007. A new stack gas flow meter was installed in June 2006.

2. Sample point

The location of the sample point was selected to provide ease of access and a location close to the analyser. The most suitable position was chosen in the tail gas of the plant downstream of all process equipment.

3. Sample Conditioning System

The gas sample is continuously taken via a heated probe and filter unit and a heated sample line. Before entering the analyser the gas is treated by a dryer unit to avoid possible moisture effects.

4. Analyser

The analyser installed at AEL No. 9 nitric acid plant to continuously monitor N_2O concentration in the stack is an ABB AO2040 Uras 14 NDIR analyser.

5. Stack gas flow meter

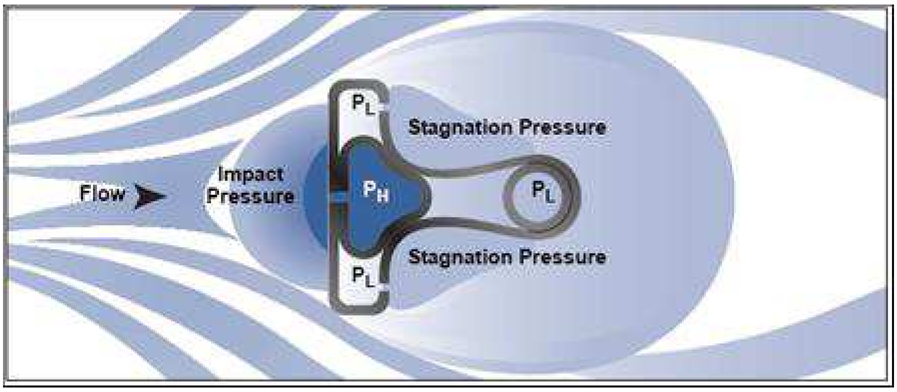
The Emerson Rosemount Flow Meter Annubar®, model no. 485, relies on the Averaging Pilot Tubes (APTs).

The Rosemount Annubar® 485 is a device used to measure the flow-velocity of a liquid, gas or steam fluid that passes through a pipe. It measures by creating a differential pressure (DP) that is proportional to the square of the velocity of the fluid in the pipe, in accordance with Bernoulli's theorem. This DP is measured and converted into a flow rate using a secondary device, such as a DP pressure transmitter.

The Annubar generates a DP by partially blocking the flow. The velocity of the fluid is decreased and stalled as it reaches the upstream surface of the Annubar sensor, thus creating the Impact Pressure. The Rosemount 485 Annubar® senses the impact pressure by utilizing a frontal slot design, which opens into the high pressure chamber.

This high pressure chamber connects directly into the DP transmitter for measurement.

As the fluid continues around the Annubar sensor, it creates a lower velocity profile on the back of the sensor, creating the low/suction pressure downstream. Individual ports, located on the backside of the Annubar sensor measure this low pressure. Working on the same principle as with high pressure, an average low pressure value is obtained in the low pressure chamber that connects directly into the transmitter for measurement. The resulting differential pressure is the difference between the impact (high) pressure reading and the suction (low) pressure reading as seen below.



6. Nitric acid production measurement

NAP is continuously measured and determined by a Coriolis mass flow meter. The product density and temperature as measured by the mass flow meter are used to calculate the concentration of the nitric acid produced. This value is then used to convert the total mass flow to 100% nitric acid produced. The correct measurement of acid concentration is checked by manual tests.

7. Monitoring plan and responsibilities

The emission reductions achieved by the project activity are monitored based on the approved baseline and monitoring methodology AM0034 (Version 2) "Catalytic reduction of N_2O inside the ammonia burner of nitric acid plants" as prepared by N.serve Environmental Services GmbH. AM0034 requires the use of the European Standard EN 14181 (2004) "Stationary source emissions - Quality assurance of automated measuring systems" as a guidance for installing and operating the Automated Monitoring System (AMS) in the nitric acid plants for the monitoring of N_2O emissions.

As an operator of the nitric acid plants since 1932 and of the No. 9 nitric acid plant since 1968, AEL staff in general and its Instrument Department in particular is accustomed to operating technical equipment to a high level of quality standards.

The Production Manager (PM) has the overall responsibility for the on-going operation of the project.

The Engineering Team Manager Electrical/Instrument (ETM E/I) is responsible for the day-to-day calibration procedure and any adjustments required to the instruments as a result of the calibrations.

The Process Controller (PC) checks the analyser regularly for any abnormal occurrences. These checks are done using a plausibility checklist, which is filled in and filed, in the control room. If there are any problems the ETM E/I is notified so that the problem can be rectified.

Operation, maintenance, calibration and service intervals are being carried out by staff from the instrumentation department according to the vendor's specifications.

All monitoring procedures at AEL are also conducted and recorded in accordance with the well established procedures under ISO 9001/14001 which is regularly audited by the South African Bureau of Standards, an independent auditing firm accredited for ISO 9001/14001 certification.

AEL derives hourly averages for all of the monitored parameters and delivers these data to N.serve. Martin Stilkenbäumer at N.serve, is responsible for the correct analysis of the delivered data in accordance with the methodology.

8. Application of EN 14181 procedures to the project

In the following, it is described how the procedures given in EN 14181 for QAL1, 2 have been practically applied at AEL No. 9 plant. QAL 3 procedures are described in section 9 below.

QAL 1

In accordance with EN 14181 an AMS shall have been proven suitable for its measuring task (composition of the flue gas) by use of the QAL1 procedure as specified by EN ISO 14956. Using this standard, it shall be proven that the total uncertainty of the results obtained from the AMS meets the specification for uncertainty stated in the applicable regulations. Such suitability testing has to be carried out under specific conditions by an independent third party on a specific testing site. A test institute shall perform all relevant tests on two identical AMS. These two AMS have to be tested in the laboratory and field.

The analyser installed at AEL No. 9 nitric acid plant to continuously monitor N_2O concentration in the stack is an ABB AO2040 Uras 14 NDIR analyser. According to ABB's own certificate, this analyser has an accuracy of better than 1% of range. This analyser has been certified[2] as meeting the requirements (QAL1) of the German emissions standards 17th BImSchV and 13th BImSchV (waste incineration plants, large furnaces and others) for the components NO, CO and SO_2. At the time of commissioning of the AMS by AEL no AMS was available that had been certified according with EN 14181 QAL1 for N_2O measurements. However, TÜV SÜD conducted and successfully completed the QAL1 tests[3] for the follow-up model of this analyser module within the same analyser series (ABB AO2000 Uras 26). Since there are no major technical differences between the two analyser models it can be assumed that the Analyser installed at the AEL No. 9 nitric acid plant meets the requirements of the QAL1 test in the same way as the follow-up model.

QAL2 and Standard Reference Measurements (SRM)

QAL2 is a procedure for the determination of the calibration function and its variability, and a test of the variability of the measured values of the AMS compared with the uncertainty given by legislation. The QAL2 tests are performed on suitable AMS that have been correctly installed and commissioned on-site (as opposed to QAL 1 which is conducted off-site). QAL 2 tests are to be performed at least every 5 years according to EN 14181 but also after major changes to the plant or changes or repairs to the AMS, which will influence the results obtained significantly.

A calibration function is established from the results of a number of parallel measurements performed with a Standard Reference Method (SRM). The variability of the measured values obtained with the AMS is

[2] TÜV Süddeutschland Bau und Betrieb GmbH (Report number 170 608), March 2003

[3] TÜV Süd Industrie Service GmbH, München (Report number 821029) June 2006

then evaluated against the required uncertainty. According to EN 14181, both the QAL 2 procedures and the SRM need to be conducted by an independent “testing house” or laboratory which has to be accredited to EN ISO/IEC 17025.

An annual surveillance test (AST) is performed between QAL2 tests to demonstrate that the AMS functions correctly, its performance remains valid and that the calibration function and variability derived during the QAL2 remains as previously determined.

9. AMS calibration and QA/QC procedures

AEL is certified according to ISO 9001 and 14001 standards for quality and environmental management respectively. The procedures for monitoring, regular calibrations and QA/QC are fully embedded into the procedures required by ISO 9001/14001 and documented in the applicable ISO handbooks. The South African Bureau of Standards (SABS) is the designated auditor for these standards at AEL. Therefore, all of the monitoring equipment is subjected to the regular “SABS testing loops” as part of the ISO 9001/14001 procedures.

QAL 3

QAL3 is a procedure which is used to check drift and precision in order to demonstrate that the AMS is in control during its operation so that it continues to function within the required specifications for uncertainty.

This is achieved by conducting periodic zero and span checks on the AMS and then evaluating the results obtained using control charts. Zero and span adjustments or maintenance of the AMS, may be necessary depending on the results of this evaluation.

Analyser Zero and Span Calibrations

The N_2O analyser is calibrated once per year by external QAL2 or AST test according to EN 14181. In addition according to the QAL1 reports and manufacturers specifications it is recommended to perform a zero/span calibration once every three weeks for the ABB URAS 14 analyser, however AEL decided to do it twice per week in order to have a closer control over the instrument. For the zero calibration pure nitrogen is used, for the span calibration a certified calibration gas is used. The results of the calibrations are recorded according to the related CDM procedure.

Calibration Gas

A certified N_2O Calibration gas (balance being N_2) with a precision of ±2% is used in the span calibrations. The calibration gas is certified by an independent laboratory (Modderfontein Laboratory Services) or by the supplier.

Modderfontein Laboratory Services (Pty) Ltd is an independent chemical analysis laboratory which is certified by the South African Bureau of Standards (SABS).

Flow meter calibration procedures

The flow meter is calibrated once per year by external QAL2 or AST test according to EN 14181. In addition the flow meter is calibrated at least once per campaign usually every 4 months after each campaign (the plant has to be shut down to conduct calibration) by the Instrument Department of AEL. The pressure transmitter is disconnected from the Annubar and the transmitter is then connected to an absolute pressure simulator that has been approved by the South Africa Bureau of Standards (SABS).

If the deviation exceeds 1% of range, then the pressure transmitter is recalibrated and the previous procedure repeated.

The Annubar itself does not need to be calibrated since it is a physical devise which will not have drift. Therefore, it is sufficient to regularly inspect the physical condition of the Annubar. Therefore, the Annubar is taken out of the stack once per year for physical inspection.

The results of these calibration procedures are then recorded in the Calibration Procedure log sheet.

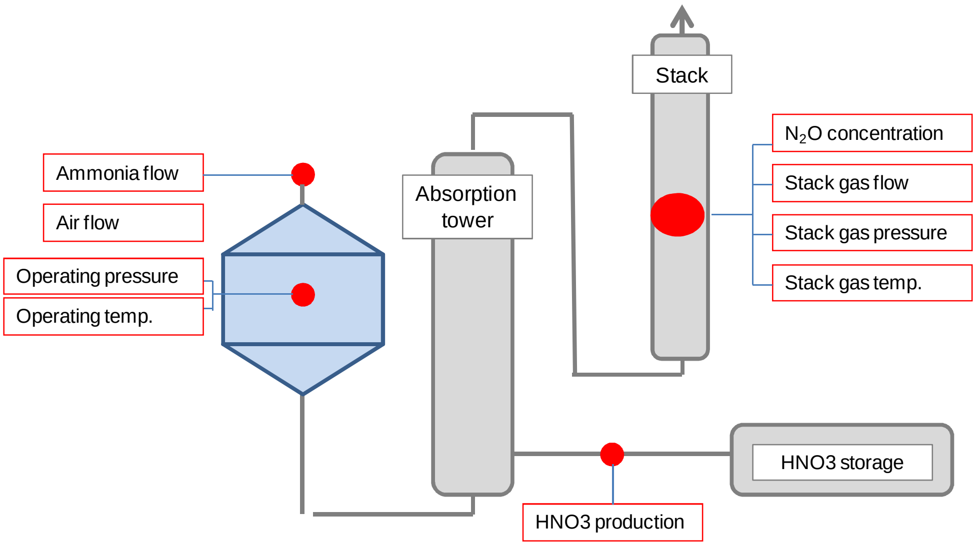


Figure: Monitoring Points for all relevant Parameters (NCSG, VSG, TSG, PSG, NAP, OTh, OPh, AFR, AIFR)

<u>Training</u>

Operations staff at the nitric acid plant who are responsible for the operation of the AMS and regular calibrations, visual and physical checks have been trained appropriately by the AMS vendors and AELs' own instrumentation engineers.

9.1. Data Acquisition System and Emergency Procedures

The analogue signal (4 to 20 mA) output from the Analyser and Flow meter are converted by the Programmable Logic Controller (PLC) into a digital signal which is then fed into the SCADA data acquisition and database system.

Each of AEL's two nitric acid plants has its own SCADA system on a dedicated PC near the respective plant itself. However, the two SCADA PCs are directly connected to each other and each of the PCs receives all of the measured data from the AMS and stores them. That way there is a constant redundancy of data acquisition and storage. In addition, the instrumentation engineer transfers the data at least once a week into AEL's main IT system as well as making a complete copy of that week's data (2-second, hourly and daily averages) onto an external disc drive. That way there are already four copies of the original and unchanged data stored in four different locations. In addition, the hourly data is sent to N.serve on a regular basis (e. g. after each campaign) where it is also stored.

The SCADA system automatically produces comma separated files stored in Microsoft Excel of the 2-second values and it also automatically produces hourly and daily average values for each of the measured parameters. The hourly averages are the basis of the analysis of the data for the purpose of the calculation of the emissions factors for the baseline and for the project campaigns. These are then extracted and converted into excel files which can then be imported into the N.serve Database Management System (N.DBMS).

N.serve Database Management System (N.DBMS)
All data necessary for the monitoring and verification procedures related to the project activity are transferred from the nitric acid plant's data acquisition system into N.serve's dedicated relational database

management system ("N.DBMS") based on Microsoft Access 2002. Database management systems are designed for a structured storage of large amounts of data providing for minimum redundancy and maximum flexibility to allow best practice data analysis.
The N.DBMS is designed to conduct all the calculation steps required by the methodology in order to derive the baseline and project emissions factors and to calculate the amount of emission reductions resulting from the project activity.

The use of the N.DBMS system is described in the PDD and therefore part of the validated monitoring plan. For the purpose of plausibility checks and for transparency reasons all calculations are also provided in an EXCEL calculation sheet. This EXCEL calculation sheet will be submitted in addition to the N.DBMS documentation sheet along with the request for issuance to allow easy crosschecks and recalculations.

SECTION D. Data and parameters
D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data/Parameter	**B.1 $NCSG_{BC}$[4]**
Unit	**mg/Nm^3**
Description	N_2O concentration in the stack gas during the baseline campaign.
Source of data	ABB AO2040 URAS 14 Continuous Emissions Analyser
Value(s) applied	Value applicable for **regular project campaigns** exceeding CL_{normal} or CL_{BL}: **1,764.44** Value applicable for Project Campaign 11 : **1,764.44** Value applicable for Project Campaign 12 : **1,707.48**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	A complete QAL2 audit in accordance with EN 14181 was conducted on the AMS in February 2008. During the QAL2 reference measurements it was determined that the analyser consistently overestimates the N_2O concentration in the stack. As a result from the QAL2 calibration curve, it was determined that a correction factor of 0.97 will has been applied to all NCSG measurements. Therefore, the mean NCSG value will be multiplied by 0.97 before going into the calculation of BE_{BC}. Calibration information During Baseline period 05/09/2007 – 06/11/2007: Bi-weekly Zero and span check and calibration in case of deviation >1% of range of analyser against zero gas and certified calibration gas cylinder (internal calibration by AEL) Documentation in form of calibration reports and shewart charts. First check for baseline period: 04/09/2007 During the baseline period: check performed twice per week Last check for baseline period: 05/11/2007 Next check after baseline period: 08/11/2007 Date of last external calibration: QAL2 Test – 07/02/2008 - 13/02/2008 valid until February 2013 The calibration error as determined during the QAL2 test was retroactively applied to the NCSG results for the baseline period in a conservative manner. Moreover the overall uncertainty of the AMS was applied in a conservative manner to the results of baseline emissions.

[4] Please note that all baseline data and historic campaign data sets have been determined after the registration as a different baseline had been selected. Please refer to section E.1. below for further detail.

Data/Parameter	**B.2 VSG_{BC}**
Unit	**Nm^3/h**
Description	Normal gas volume flow rate of the stack gas during the baseline campaign.
Source of data	Gas Volume Flow meter, Emerson Rosemount Annubar® Model 485 combined with pressure transmitter Rosemount 3051S
Value(s) applied	**42,983**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	The QAL2 test, performed by an independent 3rd party laboratory with EN ISO/IEC 17025 accreditation, include the test of the correct measurement of stack gas temperature and stack gas pressure by comparison of the AMS results of these parameters with the results of the reference measurement instruments of the testing laboratory. Moreover during the QAL2 test the correct normalization of the stack gas flow (VSG) to standard conditions is verified by comparison of the AMS results for normalized flow with the reference measurement results for normalized flow. During the QAL2 reference measurements it was determined that the flow meter consistently overestimates the total gas volume flow in the stack. As a result from the QAL2 calibration curve, it was determined that a correction factor of 0.962 will have to be applied to all VSG measurements. Therefore, the result of the above statistical analysis, i.e. the mean VSG value will be multiplied by 0.962 before going into the calculation of BE_{BC}. Calibration information During Baseline period 05/09/2007 – 06/11/2007: Internal calibrations: after each campaign (usually every 4 months) Date of internal calibration: 08/2007*) Date of internal calibration: 11/2007*) *) exact dates not available only month and year noted on calibration document Date of last external calibration: QAL2 Test – 07/02/2008 – 13/02/2008 valid until February 2013 The calibration error as determined during the QAL2 test was retroactively applied to the NCSG results for the baseline period in a conservative manner. Moreover the overall uncertainty of the AMS was applied in a conservative manner to the results of baseline emissions.

Data/Parameter	**B.3 BE_{BC}**
Unit	**tN_2O**
Description	Total N_2O mass flow during baseline campaign
Source of data	Calculation from measured data.
Value(s) applied	Value applicable for **regular project campaigns** exceeding CL_{normal} or CL_{BL}: **104.315** Value applicable for Project Campaign 11: **104.315** Value applicable for Project Campaign 12: **100.947**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Data/Parameter	**B.4 OH_{BC}**
Unit	**hours**
Description	Operating hours
Source of data	Production log and Process Control System.
Value(s) applied	**1,474**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Data/Parameter	**B.5 NAP_{BC}**
Unit	**$tHNO_3$**
Description	Metric tonnes of 100% concentrated nitric acid produced during the baseline campaign.
Source of data	Nitric acid flow meter Manufacturer: EMERSON, Type: Coriolis mass flow meter CMF 200 Laboratory results for verification purposes
Value(s) applied	**17,718**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	The nitric acid flow meter is subject of external calibration procedures every 3 years. Calibration information During Baseline period 05/09/2007 – 06/11/2007: External calibration by: ALPRET Controls Specialists Date 04/01/2007 and 11/04/2008; although the calibration is valid for 3 years, it is done more frequently

Data/Parameter	**B.6 TSG**
Unit	**°C**
Description	Temperature in the stack gas
Source of data	Stack temperature probe as part of the VSG flow meter.
Value(s) applied	**Not applicable**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	The TSG result is automatically applied for calculating VSG at standard conditions Calibration information During Baseline period 05/09/2007 – 06/11/2007 : Internal calibrations: after each campaign (usually every 4 months), validity of calibration 1 year Date of internal calibration: 08/2007*) Date of internal calibration: 11/2007*) *) exact dates not available only month and year noted on calibration document Date of last external calibration: QAL2 Test – 07/02/2008 - 13/02/2008 valid until 06/02/2013

Data/Parameter	B.7 PSG
Unit	Pa (absolute)
Description	Pressure in the stack
Source of data	Stack pressure as part of the VSG flow meter.
Value(s) applied	**Not applicable**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	The PSG result is automatically applied for calculating VSG at standard conditions Calibration information During Baseline period 05/09/2007 – 06/11/2007 : Internal calibrations: after each campaign (usually every 4 months) validity of calibration 1 year Date of internal calibration :08/2007*) Date of internal calibration :11/2007*) *) exact dates not available only month and year noted on calibration document Date of last external calibration: QAL2 Test –07/02/2008 - 13/02/2008 valid until 06/02/2013

Data/Parameter	**B.8 EF_{BL}**
Unit	**tN_2O / $tHNO_3$**
Description	Emissions factor for baseline period
Source of data	Calculated from measured data (tons of N_2O emitted / tons of nitric acid produced)
Value(s) applied	Value applicable for **regular project campaigns** exceeding CL_{normal} or CL_{BL}: **0.00564** Value applicable for Project Campaign 11: **0.00564** Value applicable for Project Campaign 12: **0.00546**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Data/Parameter	**B.9 UNC**
Unit	**%**
Description	Calculated overall uncertainty of the Automated Monitoring System (AMS)
Source of data	UNC is determined by conducting reference measurements by an independent testing laboratory with EN ISO/IEC 17025 accreditation (QAL2).
Value(s) applied	**4.20**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Data/Parameter	B.10 AFR
Unit	**tNH_3/h (converted from originally measured Nm^3/h)**
Description	Ammonia gas flow rate to the ammonia oxidation reactor
Source of data	Differential pressure measurement (orifice plate) Type: D/P
Value(s) applied	Not applicable, monitored data of AFR will be used to determine if plant was operating outside of AFR_{max}.
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	Calibration information During Baseline period 05/09/2007 – 06/11/2007 : Calibration frequency: Once every six months (validity 7 months). (only during plant shutdown between campaigns) Date of last calibrations: 04/09/2007, 10/02/2008

Data/Parameter	B.11 AFR_{max}
Unit	**tNH_3/h (converted from originally measured Nm^3/h)**
Description	Maximum Ammonia gas flow rate to the ammonia oxidation reactor
Source of data	AFR data
Value(s) applied	**3.877** Historic data of daily NH_3 consumption was used to obtain determine the range of AFR for the five historic campaigns. Table: Maximum NH_3 gas flow to the AOR (see table below) After removing the top 2.5 percentile values the maximum daily flow rate was 93.037 metric tonnes. This corresponds to an hourly flow rate of 3,877 kg/h or 5,110 Nm^3/h. The ammonia flow in Nm^3/h is used in the ratio calculation.
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Campaign No.	Start Date	End date	Total NH_3 consumed	Maximum NH_3 consumed per day
			tonnes	tonnes
H6	04/06/04	16/09/04	7,448.377	93.131
H7	24/09/04	27/12/04	7,372.149	89.508
H8	14/03/05	21/06/05	7,828.5427	92.187
H9	23/09/05	20/12/05	6,838.168	90.425
H10	17/02/06	20/07/06	6,907.924	91.204

Data/Parameter	B.12 AIFR
Unit	**% v/v**
Description	Ammonia to air ratio into the ammonia oxidation reactor
Source of data	Measurements of AFR and primary air flow rates (measured by differential pressure measurement).
Value(s) applied	**Not applicable, monitored data of AIFR will be used to determine if plant was operating outside of $AIFR_{max}$.**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	Calibration information During Baseline period 05/09/2007 – 06/11/2007 : Calibration frequency: Once every six months (validity 7 months).

	(only during plant shutdown between campaigns) Date of last calibrations: 04/09/2007, 10/02/2008

Data/Parameter	**B.13 CL_{BL}**
Unit	**$tHNO_3$**
Description	Length of the baseline campaign measured in metric tonnes of 100% concentrated nitric acid produced during that baseline campaign.
Source of data	NAP_{BC}
Value(s) applied	**17,718**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	**Adjustment of Baseline Campaign Length (CL_{BL})** As $CL_{BL} > CL_{normal}$, N_2O values that were measured beyond the length of CL_{normal} during the production of the quantity of nitric acid (i.e. the final tonnes produced) have been eliminated from the calculation of EF_{BL}.

Data/Parameter	**B.14 CL_{normal}**
Unit	**$tHNO_3$**
Description	Average length of the historic campaigns measured in metric tonnes of 100% concentrated nitric acid produced during the historic campaigns.
Source of data	Flow meter measurements as described in NAP.
Value(s) applied	**24,026.2** During the five historic campaigns, the following amounts of metric tonnes of 100% concentrated nitric acid have been produced: (see table below) Therefore, the average historic campaign length (CL_{normal}) is 24,026.2 tonnes of 100% concentrated nitric acid.
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Campaign No.	**Start Date**	**End date**	**Production ($tHNO_3$)**
			tonnes
H6	04/06/04	16/09/04	24,443.3
H7	24/09/04	27/12/04	24,041.6
H8	14/03/05	21/06/05	26,945.1
H9	23/09/05	20/12/05	24,326.1
H10	17/02/06	20/07/06	20,374.6
Mean			**24,026.2**

Data/Parameter	**B. 15 $AIFR_{max}$**
Unit	**% v/v**
Description	Maximum Ammonia to air ratio into the ammonia oxidation reactor.
Source of data	AIFR Data
Value(s) applied	**11.5**

	Since no historical data where recorded and available, the allowable NH_3 to Air ratio is taken from the controller data sheet (No 9 Ratio Controller, August 1997). The range is 8.4% v/v - 11.5% v/v, therefore the maximum ammonia to air ratio is 11.5%.
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Data/Parameter	**B.16 OT_h**
Unit	**°C**
Description	Oxidation temperature for each hour during the baseline campaign
Source of data	Monitoring results of a thermocouple inside the ammonia oxidation reactor.
Value(s) applied	**Not applicable**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	Calibration information During Baseline period 05/09/2007 – 06/11/2007: Calibration frequency: Once every campaign (validity 7 months). (only during plant shutdown between campaigns) Date of last calibrations: 04/09/2007, 10/02/2008

Data/Parameter	**B.17 OT_{normal}**
Unit	**°C (min and max)**
Description	Normal range operating temperature
Source of data	Design specifications and operating manual of the No. 9 nitric acid plant (Technical Manual (TM24 June 1977, p94)).
Value(s) applied	**810 to 915**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Data/Parameter	**B.18 OP_h**
Unit	**kPa (gauge)**
Description	Oxidation Pressure for each hour during the baseline campaign
Source of data	Monitoring results of a pressure transmitter on the ammonia oxidation reactor (ammonia to air mixer).
Value(s) applied	**Not applicable.**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	Calibration information During Baseline period 05/09/2007 – 06/11/2007: Calibration frequency: Once every six month (validity 7 months). (only during plant shutdown between campaigns) Date of last calibrations: 04/09/2007, 10/02/2008

Data/Parameter	**B.19 OP_{normal}**
Unit	**kPa (gauge) min and max**
Description	Normal range of operating pressure in the ammonia oxidation reactor as determined during the historic campaigns analysis.
Source of data	Design specifications and operating manual of the No. 9 nitric acid plant (Technical Manual (TM24 June 1977, p94)).
Value(s) applied	**860 to 910**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Data/Parameter	B.20 GS_{normal}
Unit	**Name of Supplier**
Description	Gauze supplier for the operating condition (i.e. historic) campaigns
Source of data	Monitored / Invoices
Value(s) applied	**W.C. Heraeus**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Data/Parameter	B.21 GS_{BL}
Unit	**Name of Supplier**
Description	Gauze supplier for the baseline condition campaign
Source of data	Monitored / Invoices
Value(s) applied	**W.C. Heraeus**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Data/Parameter	B.23 GC_{normal}
Unit	**%**
Description	Gauze composition during the historic operating campaigns expressed as percentage by weight of the precious metals Platinum, Rhodium and, if applicable, Palladium comprising the Ammonia Oxidation Catalyst gauzes.
Source of data	Monitored / Gauze supplier invoices
Value(s) applied	**Platinum (Pt) 59%; Rhodium (Rh) 4%; Palladium (Pd) 37%** Record of Gauze compositions installed during the historic campaigns[5]:

Campaign	Gauze Supplier	Gauze Composition		
		Pt (%)	**Rh (%)**	**Pd (%)**
H6	Heraeus	59	4	37
H7	Heraeus	59	4	37
H8	Heraeus	59	4	37
H9	Heraeus	59	4	37
H10	Heraeus	59	4	37
Average		**59**	**4**	**37**

Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Data/Parameter	B.24 GC_{BL}
Unit	**%**
Description	Gauze composition during the baseline campaign expressed as percentage by weight of the precious metals Platinum, Rhodium and, if applicable, Palladium comprising the Ammonia Oxidation Catalyst gauzes.
Source of data	Monitored / Gauze supplier invoices
Value(s) applied	**Platinum (Pt) 59; Rhodium (Rh) 4; Palladium (Pd) 37**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

[5] The figures shown here are rounded figures. More exact figures are commercially sensitive information but can be inspected by the DOE during the site visit and can be made available to the CDM EB upon request.

Data/Parameter	B.26 EF_{reg}
Unit	$tN_2O/tHNO_3$
Description	Emissions cap for N_2O from nitric acid production set by government regulation
Source of data	Department of Environmental Affairs and Tourism
Value(s) applied	**None**
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None.

D.2. Data and parameters monitored

Data/Parameter	**NCSG**
Unit	**mg / Nm³** (convertible from ppmv, if required)
Description	N_2O concentration in the stack gas during each project campaign.
Measured/Calculated /Default	Measured/Calculated - every 2 sec. used for calculation of campaign mean (average, after exclusion of extreme values and outliers)
Source of data	ABB AO2040 URAS 14 Continuous Emissions Analyser
Value(s) of monitored parameter	Value applicable for Project Campaign 11: **339.23** Value applicable for Project Campaign 12: **212.57**
Monitoring equipment	Type: *ABB AO2040 URAS 14 Continuous Emissions Analyser, non-dispersive infrared analyser* Measurement accuracy (for N_2O): *2.69 % (per QAL 2 test)* Serial Number: 3.346854.7 Calibration frequency: - *External calibration: QAL2 every 5 years*; - *External calibration: AST every year*; - *Internal check: twice per week manual zero and span check and calibration in case of deviation >1% of range of analyser against zero gas and certified calibration gas cylinder (internal calibration by AEL) Documentation in form of calibration reports and Shewart charts.* First check for monitoring period: 26/07/2011 During the monitoring period: checks performed twice per week Last check for monitoring period: 08/03/2012 Next check after monitoring period: 13/03/2012 Date of last external calibration: *QAL2 Test (including AST) – 21/06/2011 - 24/06/2011 valid until 20/06/2016*
Measuring/Reading/ Recording frequency	Continuously (every 2 seconds)

Calculation method (if applicable)	AM0034 requires the determination of the concentration of N_2O in the stack gas. NCSG is continuously monitored with an NDIR gas analyser and monitoring results are taken and recorded for every two seconds of plant operation. Hourly means for NCSG are derived by the data acquisition system. NCSG data taken during times when the plant was out of operation were eliminated. Also readings that were taken during malfunction of the monitoring system were eliminated. The remaining hourly average values where subjected to the following statistical analysis: 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 NCSG values During the QAL2 reference measurements it was determined that the analyser consistently overestimates the N_2O concentration in the stack. As a result from the QAL2 calibration curve, it was determined that a correction factor of 0.97 will have to be applied to all NCSG measurements. Therefore, the result of the above statistical analysis, i.e. the mean NCSG value will be multiplied by 0.97 before going into the calculation of PE_n.
QA/QC procedures	Bi-weekly zero and span check and calibration in case of deviation >1% of range of analyser against zero gas and certified calibration gas cylinder (internal calibration by AEL) every 5 years QAL2 test (including AST) according to EN 14181 (External by qualified institute) yearly AST test according to EN 14181 (External by qualified institute)
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	

Data/Parameter	**VSG**
Unit	**Nm^3/h**
Description	Normal gas volume flow rate of the stack gas during each project campaign.
Measured/Calculated /Default	Measured/Calculated **-** every **2** sec. used for calculation of campaign mean (average, after exclusion of extreme values and outliers)
Source of data	Gas volume flow meter, Emerson Rosemount Annubar® Model 485 combined with pressure transmitter Rosemount 3051S
Value(s) of monitored parameter	Value applicable for Project Campaign 11: **41,428** Value applicable for Project Campaign 12: **40,463**
Monitoring equipment	Type: Emerson Rosemount Annubar® Model 485 combined with pressure transmitter Rosemount 3051S Overall measurement accuracy: 2.65% *(accuracy for the flowmeter per QAL 2 test, before correction of the result to standard conditions by TSG and PSG)* Serial Number: 0305RT32A11B3 Calibration frequency: - *External calibration: QAL2 every 5 years*; - *External calibration: AST every year*; - *Internal calibrations: after each campaign (usually every 4 months) validity of calibration is 7 month* Date of internal calibration :15/06/2011 Date of internal calibration :01/11/2011 Date of internal calibration :12/04/2012 Date of last external calibration: *QAL2 Test (including AST) – 21/06/2011 - 24/06/2011 valid until 20/06/2016*
Measuring/Reading/ Recording frequency	Continuously (every 2 seconds).

Calculation method (if applicable)	AM0034 requires the determination of the gas volume flow (VSG) in the stack. VSG is continuously monitored with a flow meter and monitoring results are taken and recorded for every two seconds of plant operation. Hourly means for VSG are derived by the data acquisition system. Temperature and pressure is also continuously measured in the stack and the VSG values subsequently adjusted to derive the VSG at normal conditions (i.e. standard pressure and temperature). VSG data taken during times when the plant was out of operation were eliminated. The resulting hourly average VSG values are now expressed in Nm^3/h as required by AM0034 and where subsequently subjected to the following statistical analysis: 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 VSG values During the QAL2 reference measurements it was determined that the flow meter consistently underestimates the total gas volume flow in the stack. As a result from the QAL2 calibration curve, it was determined that a correction factor of 1.02 will have to be applied to all VSG measurements. Therefore, the result of the above statistical analysis, i.e. the mean VSG value will be multiplied by 1.02 before going into the calculation of PE_n.
QA/QC procedures	Internal calibration at least once per campaign usually every 4 months after each campaign (the plant has to be shut down to conduct calibration) by the Instrument Department of AEL. every 5 years QAL2 test (including AST) according to EN 14181 (External by qualified institute) yearly AST test according to EN 14181 (External by qualified institute)
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	

Data/Parameter	**PE_n**
Unit	**tN_2O**
Description	Total mass N_2O emissions in each project campaign.
Measured/Calculated /Default	Calculated.
Source of data	Calculated from measured values.
Value(s) of monitored parameter	Value applicable for Project Campaign 11 : **33.789** Value applicable for Project Campaign 12 : **8.918**
Monitoring equipment	Not applicable.
Measuring/Reading/ Recording frequency	Not applicable.
Calculation method (if applicable)	$PE_n = VSG * NCSG * 10^{-9} * OH$ A special correction function is applied to the results for NCSG and VSG values. These correction factors were determined during the QAL2 test according to EN 14181.
QA/QC procedures	Not applicable.
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	

Data/Parameter	**OH_n**
Unit	**Hours**
Description	Total operating hours during each project campaign
Measured/Calculated /Default	Measured.
Source of data	Production log and continuous monitoring.
Value(s) of monitored parameter	Project Campaign 11: 2,430 Project Campaign 12: 1,048
Monitoring equipment	Not applicable.
Measuring/Reading/ Recording frequency	The total operating hours are logged continuously.
Calculation method (if applicable)	Not applicable.
QA/QC procedures	The production logging process is subject to ISO 9001 procedures
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	

Data/Parameter	**NAP**
Unit	**$tHNO_3$**
Description	Metric tonnes of 100% concentrated nitric acid during each project campaign.
Measured/Calculated /Default	Measured / Calculated.
Source of data	Nitric acid flow meter Emerson coriolis mass flow meter Laboratory results.
Value(s) of monitored parameter	Project Campaign 11: 29,285 Project Campaign 12: 12,706
Monitoring equipment	Emerson coriolis mass flow meter CMF 200 Overall measurement accuracy: *<=0.1%* Serial Number: 12032709 Calibration frequency: every 3 years Date of last calibration, 24/11/2010 valid until 23/11/2013
Measuring/Reading/ Recording frequency	NAP is determined by continuous measurement of the HNO_3 production and concentration
Calculation method (if applicable)	NAP is determined by a mass flow meter according to the following procedures: The density and temperature as measured by the mass flow meter is used to calculate the concentration of the nitric acid produced. This value is then used to convert the total mass flow to 100% nitric acid produced. The correct measurement of acid concentration is checked by manual tests.
QA/QC procedures	The mass flow meter is calibrated in regular intervals. NAP results are crosschecked against process parameters as ammonia consumption and against product stock levels and product consumption
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	The design capacity of the plant is 292.112 metric tonnes per day, operating 365 days per year. This equals a total production of 70,399 tonnes for a period of 241 days. Therefore the factual production of 41,991 tonnes during this monitoring period is below the design capacity of the plant.

Data/Parameter	**TSG**
Unit	**°C**
Description	Temperature in the stack gas
Measured/Calculated /Default	Measured.
Source of data	Stack temperature probe situated directly next to the volume flow meter;
Value(s) of monitored parameter	Not applicable, directly used for normalization of tail gas volume flow measurement.
Monitoring equipment	Type: PT 100_385 3-wire RTD - part of the Gas Volume Flow meter Overall measurement accuracy: 2.55*% (per QAL2 test)* Serial Number: *not available* Calibration frequency: - *External calibration: QAL2 every 5 years*; - *External calibration: AST every year*; *Internal calibration: after each campaign (usually every 4 months) validity of calibration is 7 month* Date of internal calibration :15/06/2011 Date of internal calibration :01/11/2011 Date of internal calibration :12/04/2012 Date of last external calibration: *QAL2 Test (including AST) – 21/06/2011 - 24/06/2011 valid until 20/06/2016*
Measuring/Reading/ Recording frequency	Continuously (every 2 seconds)
Calculation method (if applicable)	AM0034 requires the determination of gas volume flow at normal conditions in the stack. In order to calculate from the measured VSG values to VSG at normal conditions, the actual temperature in the stack is measured by a temperature probe as part of the flow meter. The resulting measurements are transferred to the data acquisition system and are applied to each VSG value for calculation of normal volume flow.
QA/QC procedures	Internal calibration at least once per campaign usually every 4 months after each campaign (the plant has to be shut down to conduct calibration) by the Instrument Department of AEL. The validity of the internal calibrations is 1 year. every 5 years QAL2 test (including AST) according to EN 14181 (External by qualified institute) yearly AST test according to EN 14181 (External by qualified institute)
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	

Data/Parameter	**PSG**
Unit	**Pa(absolute)**
Description	Pressure in the stack
Measured/Calculated /Default	Measured.
Source of data	Stack pressure probe situated directly next to the volume flow meter.
Value(s) of monitored parameter	Not applicable, directly used for normalization of tail gas volume flow measurement.
Monitoring equipment	Type: part of the Gas Volume Flow meter, Rosemount 3051TA1A2B21BB4I1M5Q4 Overall measurement accuracy: 0.7% *(per QAl2 test)* Serial Number: 338640.1.1 Calibration frequency: - *External calibration: QAL2 every 5 years*; - *External calibration: AST every year*; *Internal calibration: after each campaign (usually every 4 months) validity of calibration is 7 month* Date of internal calibration :15/06/2011 Date of internal calibration :01/11/2011 Date of internal calibration :12/04/2012 Date of last external calibration: *QAL2 Test (including AST) – 21/06/2011 - 24/06/2011 valid until 20/06/2016*
Measuring/Reading/ Recording frequency	Continuously (every 2 seconds).
Calculation method (if applicable)	AM0034 requires the determination of gas volume flow at normal conditions in the stack. In order to calculate from the measured VSG values to VSG at normal conditions, the actual pressure in the stack has to be determined and transferred to the DURAG system and applied to each VSG value for calculation of normal volume flow.
QA/QC procedures	Internal calibration at least once per campaign usually every 4 months after each campaign (the plant has to be shut down to conduct calibration) by the Instrument Department of AEL. The validity of the internal calibrations is 1 year. every 5 years QAL2 test (including AST) according to EN 14181 (External by qualified institute) yearly AST test according to EN 14181 (External by qualified institute)
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	

Data/Parameter	EF_n
Unit	$tN_2O/tHNO_3$
Description	Emissions factor for campaign n.
Measured/Calculated /Default	Calculated.
Source of data	Calculation from total mass N_2O emissions of campaign n (PE_n) and total nitric acid production (NAP_n)
Value(s) of monitored parameter	Project Campaign 11: 0.001154 Project Campaign 12: 0.000702
Monitoring equipment	Not applicable.
Measuring/Reading/ Recording frequency	Not applicable.
Calculation method (if applicable)	The campaign specific emissions factor for each campaign during the project's crediting period is calculated 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 campaign *n* the campaign specific emission factor is: $EF_n = PE_n / NAP_n$
QA/QC procedures	Not applicable.
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	

Data/Parameter	$EF_{ma,n}$
Unit	$tN_2O/tHNO_3$
Description	Moving average emissions factor derived over time from campaign specific emissions factors.
Measured/Calculated /Default	Calculated.
Source of data	Calculation from campaign specific emissions factors (EF_n)
Value(s) of monitored parameter	Project Campaign 11: 0.0013004 Project Campaign 12: 0.001250
Monitoring equipment	Not applicable.
Measuring/Reading/ Recording frequency	Not applicable.
Calculation method (if applicable)	In order to take into account possible long-term emissions trends over the duration of the project activity and to take a conservative approach the moving average emission factor is determined as follows: $EF_{ma,n} = (EF_1 + EF_2 + \ldots + EF_n) / n$ This process is repeated for each campaign such that a moving average, $EF_{ma,n}$ is established over time, becoming more representative and precise with each additional campaign.
QA/QC procedures	Not applicable.
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	

Data/Parameter	EF_p
Unit	$tN_2O/tHNO_3$
Description	Emissions factor used for the specific campaign n to determine the emission reductions of that campaign
Measured/Calculated /Default	Calculated.
Source of data	Calculation of EF_n and $EF_{ma,n}$.
Value(s) of monitored parameter	Project Campaign 11: 0.001300 Project Campaign 12: 0.001250
Monitoring equipment	Not applicable.
Measuring/Reading/ Recording frequency	Not applicable.
Calculation method (if applicable)	To calculate the total emission reductions achieved in a campaign, the higher of the two values $EF_{ma,n}$ and EF_n shall be applied as the emission factor relevant for the particular campaign to be used to calculate emissions reductions (EF_P). Thus: If $EF_{ma,n} > EF_n$ then $EF_P = EF_{ma,n}$ If $EF_{ma,n} < EF_n$ then $EF_P = EF_n$
QA/QC procedures	Not applicable.
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	

Data/Parameter	EF_{min}
Unit	$tN_2O/tHNO_3$
Description	EF_{min} is equal to the lowest EF_n observed during the first 10 campaigns of the project crediting period.
Measured/Calculated /Default	Calculated.
Source of data	Calculations from EF_n
Value(s) of monitored parameter	0.000267
Monitoring equipment	Not applicable.
Measuring/Reading/ Recording frequency	Not applicable.
Calculation method (if applicable)	A campaign-specific emissions factor shall be used to cap any potential long-term trend towards decreasing N_2O emissions that may result from a potential 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 shall use EF_{min} and not EF_n.
QA/QC procedures	Not applicable.
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	

Data/Parameter	**EF_{reg}**
Unit	**$tN_2O/tHNO_3$**
Description	Emissions cap for N_2O from nitric acid production set by government regulation
Measured/Calculated /Default	Default
Source of data	Government policies
Value(s) of monitored parameter	No regulations or other requirements exist
Monitoring equipment	Not applicable.
Measuring/Reading/ Recording frequency	Each reporting period
Calculation method (if applicable)	Not applicable
QA/QC procedures	Not applicable.
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	

Data/Parameter	**CL_n**
Unit	**$tHNO_3$**
Description	Length of each project campaign measured in metric tonnes of 100% concentrated nitric acid produced during that campaign.
Measured/Calculated /Default	Measured.
Source of data	NAP
Value(s) of monitored parameter	Project Campaign 11: 29,285 Project Campaign 12: 12,706
Monitoring equipment	See comments for NAP above
Measuring/Reading/ Recording frequency	See comments for NAP above
Calculation method (if applicable)	In accordance with AM0034 the project length (CL_n) has to be compared to the established average historic campaign length (CL_{normal}); and 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 (subject to the elimination of data from the operational parameters analysis). If $CL_n < CL_{normal}$, recalculate EF_{BL} by eliminating those N_2O values that were obtained during the production of tonnes of nitric acid beyond the CL_n (i.e. the last tonnes produced) from the calculation of EF_n.
QA/QC procedures	See comments for NAP above
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	The design capacity of the plant is 292.112 metric tonnes per day, operating 365 days per year. This equals a total production of 70,399 tonnes for a period of 241 days. Therefore the factual production of 41,991 tonnes during this monitoring period is below the design capacity of the plant.

Data/Parameter	**OP_h**
Unit	**kPa (gauge)**
Description	Oxidation Pressure for each hour
Measured/Calculated /Default	Measured.
Source of data	Pressure probe at ammonia to air mixer.
Value(s) of monitored parameter	**Not applicable. Used to determine when plant is operating outside of permitted range during baseline campaign or if the plant is out of operation.**
Monitoring equipment	Type: Yokogawa Press Tx – pressure transmitter Overall measurement accuracy: 1.7 % Serial Number: 12C805780329 Calibration frequency: Once every six months. (only during plant shutdown between campaigns) - Date of last calibration: 22/07/2011, 01/02/2012, 12/04/2012
Measuring/Reading/ Recording frequency	The measurement results are taken by the data acquisition and evaluation system. The system directly calculates hourly averages.
Calculation method (if applicable)	See above
QA/QC procedures	The instrument is subject to yearly internal calibrations. The QA/QC procedures are part of the ISO 9001 procedures.
Purpose of data	Not applicable
Additional comment	

Data/Parameter	**OT_h**
Unit	**°C**
Description	Oxidation temperature in the ammonia oxidation reactor (AOR) for each hour.
Measured/Calculated /Default	Measured.
Source of data	Thermocouples inside the ammonia oxidation reactor
Value(s) of monitored parameter	**Not applicable. Used to determine when plant is operating outside of permitted range during baseline campaign or if the plant is out of operation.**
Monitoring equipment	Type: Thermocouple products; K-6 Multipoints Thermocouple Assembly Overall measurement accuracy: 1 % Serial Number: TP3138 Calibration frequency: Once every campaign (only during plant shutdown between campaigns) Date of last calibration: 25/07/2011, 01/11/2011, 01/02/2012, 12/04/2012
Measuring/Reading/ Recording frequency	The measurement results are taken by the data acquisition and evaluation system. The system directly calculates hourly averages.
Calculation method (if applicable)	See above.
QA/QC procedures	The instrument is subject to yearly internal calibrations, which are part of the ISO 9001 procedures.
Purpose of data	Not applicable
Additional comment	

Data/Parameter	**AFR**
Unit	**$kgNH_3/h$ (converted from originally measured Nm^3/h)**
Description	Ammonia gas flow rate to the ammonia oxidation reactor.
Measured/Calculated /Default	Measured.
Source of data	Differential pressure measurement Manufacturer: Yokogawa Type: D/P
Value(s) of monitored parameter	**Not applicable, monitored data of AFR will be used to determine if the plant operating outside of AFR_{max} during the baseline campaign or for plausibility checks**
Monitoring equipment	Type: Yokogawa Orifice plate with D.P. transmitter Overall measurement accuracy: 1.25 % Serial Number: 91H520733822 Calibration frequency: Once every six months. (only during plant shutdown between campaigns) Date of last calibration: 22/07/2011, 01/02/2012, 12/04/2012
Measuring/Reading/ Recording frequency	The measurement results are taken by the data acquisition and evaluation system. The system directly calculates hourly averages.
Calculation method (if applicable)	See above
QA/QC procedures	The instrument is subject to yearly internal calibrations, which are part of the ISO 9001 procedures.
Purpose of data	Not applicable
Additional comment	

Data/Parameter	**AIFR**
Unit	**% v/v**
Description	Ammonia to air ratio into the ammonia oxidation reactor
Measured/Calculated /Default	Calculated (primary air flow measured as basis for AIFR).
Source of data	Calculation for each hour of plant operation based on measurements of AFR and primary air flow rates.
Value(s) of monitored parameter	**Not applicable, monitored data of AIFR will be used to determine if the plant operating outside of $AIFR_{max}$ during the baseline campaign or for plausibility checks**
Monitoring equipment	Equipment for Air Flow-rate to AOR: Type: Yokogawa Orifice plate with D.P. transmitter Overall measurement accuracy: *1,66%* Serial Number: F570EK384627 Calibration frequency: Once every six months. (only during plant shutdown between campaigns) Date of last calibration: 22/07/2011, 01/02/2012, 12/04/2012
Measuring/Reading/ Recording frequency	The measurement results are taken by the data acquisition and evaluation system. The system directly calculates hourly averages.
Calculation method (if applicable)	The calculation of AIFR is based on the measurement of AFR and primary air flow-rate. The AFR measurement is described in section AFR above. The measurement of primary air flow-rate to AOR is based on differential pressure measurement principle.
QA/QC procedures	Not applicable.
Purpose of data	Not applicable.
Additional comment	

Data/Parameter	**$GS_{project}$**
Unit	**Name of Supplier**
Description	Gauze supplier for the project campaign
Measured/Calculated /Default	Not applicable.
Source of data	Monitored / Invoices
Value(s) of monitored parameter	**W.C. Heraeus**
Monitoring equipment	Not applicable.
Measuring/Reading/ Recording frequency	Not applicable.
Calculation method (if applicable)	Not applicable.
QA/QC procedures	Not applicable.
Purpose of data	Not applicable.
Additional comment	

<table>
<tr><td>Data/Parameter</td><td>$GC_{project}$</td></tr>
<tr><td>Unit</td><td>%</td></tr>
<tr><td>Description</td><td>Gauze composition during the project campaign expressed as % by weight of the precious metals Platinum, Rhodium and, if applicable, Palladium comprising the Ammonia Oxidation Catalyst gauzes.</td></tr>
<tr><td>Measured/Calculated /Default</td><td>Not applicable.</td></tr>
<tr><td>Source of data</td><td>Monitored / Gauze supplier invoices</td></tr>
<tr><td>Value(s) of monitored parameter</td><td><table><tr><td></td><td>Project campaign 11</td><td>Project campaign 12</td></tr><tr><td>Platinum (Pt)</td><td>60%</td><td>58.56%</td></tr><tr><td>Rhodium (Rh)</td><td>3.9%</td><td>3.86%</td></tr><tr><td>Palladium (Pd)</td><td>36.1%</td><td>37.58%</td></tr></table></td></tr>
<tr><td>Monitoring equipment</td><td>Not applicable.</td></tr>
<tr><td>Measuring/Reading/ Recording frequency</td><td>Not applicable.</td></tr>
<tr><td>Calculation method (if applicable)</td><td>Not applicable.</td></tr>
<tr><td>QA/QC procedures</td><td>Not applicable.</td></tr>
<tr><td>Purpose of data</td><td>Not applicable.</td></tr>
<tr><td>Additional comment</td><td></td></tr>
</table>

D.3. Implementation of sampling plan
>>
Not applicable

SECTION E. Calculation of emission reductions or GHG removals by sinks
E.1. Calculation of baseline emissions or baseline net GHG removals by sinks
>>
N.serve Database Management System (N.DBMS)
All data necessary for the monitoring and verification procedures related to the project activity are transferred from the nitric acid plant's data acquisition system into N.serve's dedicated relational database management system ("N.DBMS") based on Microsoft Access 2002. Database management systems are designed for a structured storage of large amounts of data providing for minimum redundancy and maximum flexibility to allow best practice data analysis.
The N.DBMS is designed to conduct all the calculation steps required by the methodology in order to derive the baseline and project emissions factors and to calculate the amount of emission reductions resulting from the project activity.

The use of the N.DBMS system is described in the PDD and therefore part of the validated monitoring plan. For the purpose of plausibility checks and for transparency reasons all calculations are also provided in an EXCEL calculation sheet. This EXCEL calculation sheet will be submitted in addition to the N.DBMS documentation sheet along with the request for issuance to allow easy crosschecks and recalculations.

Analysis of Historical campaign data

The monitoring results for Oxidation Temperature and Pressure have been routinely discarded in the past and are therefore not available to establish the normal range. As a substitute, the technical manuals of the No. 9 nitric acid plant were used to derive these normal ranges. See section D.1 for details.

Historic data of daily NH_3 consumption was used to determine the range of AFR for the five historic campaigns (excluding abnormal campaigns). After removing the top 2.5 percentile values the maximum daily flow rate was derived which was then converted into an hourly Ammonia flow rate, which was used to determine AIFR.

The parameters CL_{normal}, GS_{normal}, GC_{normal} and AFR_{max} were derived from the 5 historic campaigns that were defined in the PDD. The 5 campaigns are:

H6	04/06/2004	16/09/2004
H7	24/09/2004	27/12/2004
H8	14/03/2005	21/06/2005
H9	23/09/2005	20/12/2005
H10	17/02/2006	20/07/2006

The following data was established from the above mentioned sources as permitted operating conditions:

Oxidation temperature (min – max):	810 °C – 915 °C
Oxidation pressure (min – max):	860,000 Pa – 910,000 Pa
Maximum ammonia flow rate:	3.877 t/h
Maximum ammonia to air ratio:	0,115 or 11,5%
CL_{normal}:	24,026.2 $tHNO_3$

Analysis of Baseline campaign data

As the baseline campaign for AEL No. 9 the campaign AEL No 9 H15 was used. The baseline campaign was in operation in the period 05/09/2007 – 06/11/2007. The baseline monitoring data, baseline calculation and baseline results were determined during the first verification and were verified by the DOE during the first verification.
The results are as follows:

$NCSG_{BL}$	mg/Nm³	1,764.44
QAL2 NCSG		0.97
VSG_{BL}	Nm³/h	42,983
QAL2 VSG		0.962
OH_{BL}	h	1,474
NAP_{BL}	t HNO_3	17,718
BE	t N_2O	104.315

UNC		4.20
EF_{BL}	**kg N_2O/t HNO_3**	**5.64**

Resulting EF_{BL}

The EF_{BL} derived from this analysis of historic and baseline data is 5.64 kgN_2O/tHNO3.

Adjustment of Baseline Emission Factor if $CL_n < CL_{normal}$

If the length of an 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_{BL}. If $CL_n < CL_{normal}$, EF_{BL} has to 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_{BL}.

For the project campaign 11 the CL_n is longer than CL_{BL}, therefore no adjustment of the Baseline emissions factor EF_{BL} is necessary.

For the project campaign 12 $CL_n < CL_{normal}$ and $CL_n < CL_{BL}$, EF_{BL} is recalculated by eliminating those N_2O values that were obtained during the production of tonnes of nitric acid beyond the CL_{BL} (i.e. the last tonnes produced) from the calculation of EF_{BL}. This was the case at 20/10/2007 09:00 therefore all N_2O data measured after this hour were excluded for the recalculation of EF_{BL}.

The results are as follows:

$NCSG_{BL}$	mg/Nm³	1,707.48
QAL2 NCSG		0.97
VSG_{BL}	Nm³/h	42,983
QAL2 VSG		0.962
OH_{BL}	h	1,474
NAP_{BL}	t HNO_3	17,718
BE	t N_2O	100.947
UNC		4.20
EF_{BL}	**kg N_2O/t HNO_3**	**5.46**

As a result of this recalculation the new EF_{BL} to be applied for this project campaign is 5.46 kgN_2O/tHNO_3

Adjustment of Baseline emissions factor due to EF_{reg}

Should N_2O emissions regulations that apply to nitric acid plants be introduced in the host country or jurisdiction covering the location of the project activity, such regulations shall be compared to the calculated baseline emission factor for the project (EF_{BL}). If the regulatory limit is lower than the baseline factor determined for the project, the regulatory limit shall serve as the new baseline emission factor, that is:

if $EF_{BL} > EF_{reg}$,

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} shall 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.

There is currently no N_2O regulation for nitric acid plants in South Africa therefore no adjustment of the Baseline emissions factor EF_{BL} is necessary.

E.2. Calculation of project emissions or actual net GHG removals by sinks

>>
Project emissions are calculated according to the following formula:

$$PE_n = VSG * NCSG * 10^{-9} * OH$$

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)

Based on the total N_2O emissions of each project campaign the specific project campaign emission factor is calculated as:

$$EF_n = PE_n / NAP_n$$

Where:

Variable	**Definition**
EF_n	Project Emission Factor for n^{th} project campaign ($kgN_2O/tHNO_3$)
PE_n	Total N_2O emissions of the n^{th} project campaign (tN_2O or kgN_2O)
NAP_n	Campaign length of the n^{th} project campaign ($tHNO_3$)

Before calculation of the Project Emissions (PE) the same statistical analysis as for the calculation of the baseline emission factor (EF_{BL}) is applied to the monitoring raw data (hourly average values) of each project campaign.

The respective correction functions for NCSG and VSG as determined during the relevant QAL2 test are applied within the calculation.

According to the methodology, error readings and extreme values are to be eliminated from the raw data before the calculation of emission reductions. For the period 15/08/2011 10:00 hours - 29/08/2011 09:00 hours the sample gas was diluted due to a badly connected tube to the sampling gas pump. It was observed that on 09/02/2012 (from 05:00 to 14:00 hours) the N_2O analyser was not showing the correct reading due

to problems with the condensate pump. The NCSG values for these periods were eliminated before the calculation of emission reductions.

Analysis of Project campaign data

Query 1 (Raw data): Analysis of the raw campaign data

This set of data shows a summary of the collected raw data for the complete project campaign.

N.DBMS Project Campaign Calculatioi	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	; 26.07.2011 - 18.12.2011		
Project campaign 11	**Query 1: Without parameter limits**								208
Parameter	**OH**	**AFR**	**AIFR**	**Oph**	**OTh**	**NCSG**		**VSG**	**NAP**
Unit	h	t NH3 / h	ratio	Pa	°C	mg N2O / Nm3		Nm3 / h	t HNO3
Count	3,482	3,482	3,482	3,482	3,482	3,146		3,482	
Minimum		0.00	0.00	187	800	0.00		7	
Maximum		3.31	0.8	917,459	904	2,546		42,641	
Mean		2.07	0.15	625,428	869	273		29,665	
Standard deviation		1.357	0.16	409,586	46	285		17,610	
95% confidence level *(1.96 * Std.dev.)*		*2.66*	*0.32*	*802,788*	*90*	*558*		*34,516*	
Sum	3,482								29,285
Limits acc. to consistency check									
Lower limit									
Upper limit									
According to this Query 1, the NAP value of Project campaign 11 is 29,285 t of nitric acid									

N.DBMS Project Campaign Calculatioi	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	; 04.01.2012 - 11.03.2012		
Project campaign 12	**Query 1: Without parameter limits**								228
Parameter	**OH**	**AFR**	**AIFR**	**Oph**	**OTh**	**NCSG**		**VSG**	**NAP**
Unit	h	t NH3 / h	ratio	Pa	°C	mg N2O / Nm3		Nm3 / h	t HNO3
Count	1,632	1,632	1,632	1,632	1,632	1,622		1,632	
Minimum		0.00	0.00	340	801	0.00		672	
Maximum		3.27	0.7	910,628	902	3,927		43,405	
Mean		1.90	0.09	576,079	864	165		26,994	
Standard deviation		1.418	0.06	423,511	47	278		17,813	
95% confidence level *(1.96 * Std.dev.)*		*2.78*	*0.12*	*830,082*	*93*	*546*		*34,913*	
Sum	1,632								12,706
Limits acc. to consistency check									
Lower limit									
Upper limit									
According to this Query 1, the NAP value of Project campaign 12 is 12,706 t of nitric acid									

Query 2: Elimination of faulty data outside operational limits

In this query (Query 2), the operational limits of the plant are applied. Lines of data in which at least one value indicates that the plant is out of operation (trip values) are completely eliminated from further analysis. The design "trip" temperature, i.e. the temperature inside the ammonia oxidation reactor below which the plant shuts down automatically has been applied to exclude such lines of data. During the project, the "trip temperature" of 810 °C will be applied as the exclusion criterion for determining those hours during which the plant was offline during a campaign.

N.DBMS Project Campaign Calculatioi	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	; 26.07.2011 - 18.12.2011		
Project campaign 11	**Query 2: With operational limits**								212
Parameter	**OH**	**AFR**	**AIFR**	**Oph**	**OTh**	**NCSG**		**VSG**	**NAP**
Unit	h	t NH3 / h	ratio	Pa	°C	mg N2O / Nm3		Nm3 / h	t HNO3
Count	2,430	2,430	2,430	2,430	2,430	2,094		2,430	
Remaining share of data sets	69.8%	69.8%	69.8%	69.8%	69.8%	66.6%		69.8%	
Minimum		0.39	0.04	137,550	811	54		9,153	
Maximum		3.31	0.10	917,459	904	2,546		42,641	
Mean		2.96	0.10	891,776	899	390		41,082	
Standard deviation		0.234	0.004	70,464	8.8	260		2,691	
95% confidence level *(1.96 * Std.dev.)*		0.460	0.007	138,109	17.2	510		5,274	
Sum	2,430								29,285
Limits acc. to consistency check									
Lower limit					810				
Upper limit									
As a result of this query the number of operation hours OH of Project campaign 11 is 2,430 h.									

N.DBMS Project Campaign Calculatioi Project:		AEL No. 9, Johannesburg, South Africa				Campaign:	; 04.01.2012 - 11.03.2012		
Project campaign 12	**Query 2: With operational limits**								232
Parameter	**OH**	**AFR**	**AIFR**	**Oph**	**OTh**	**NCSG**		**VSG**	**NAP**
Unit	h	t NH3 / h	ratio	Pa	°C	mg N2O / Nm3		Nm3 / h	t HNO3
Count	1,048	1,048	1,048	1,048	1,048	1,038		1,048	
Remaining share of data sets	64.2%	64.2%	64.2%	64.2%	64.2%	64.0%		64.2%	
Minimum		1.05	0.06	305,814	813	99		16,814	
Maximum		3.27	0.10	910,628	902	3,927		43,405	
Mean		2.95	0.09	889,639	899	251		40,137	
Standard deviation		0.197	0.003	57,423	7.1	316		2,180	
95% confidence level *(1.96 * Std.dev.)*		0.385	0.005	112,548	13.8	619		4,272	
Sum	1,048								12,706
Limits acc. to consistency check									
Lower limit					810				
Upper limit									
As a result of this query the number of operation hours OH of Project campaign 12 is 1,048 h.									

Query 6: application of confidence interval to eliminate outliers

The 95% confidence interval for NCSG and VSG values is derived and the outliers excluded individually for VSG and NCSG. Hence, the remaining number of data sets may differ between NCSG and VSG.

N.DBMS Project Campaign Calculatioi Project:		AEL No. 9, Johannesburg, South Africa				Campaign:	; 26.07.2011 - 18.12.2011		
Project campaign 11	**Q6: Q2 + confidence levels**					216		220	212
Parameter	**OH**	**AFR**	**AIFR**	**Oph**	**OTh**	**NCSG**		**VSG**	**NAP**
Unit	h	t NH3 / h	ratio	Pa	°C	mg N2O / Nm3		Nm3 / h	t HNO3
Count						1,944		2,379	
Remaining share of data sets									
Minimum		0.390	0.04	137,550	811	54		35,967	
Maximum		3.31	0.10	917,459	904	898		42,641	
Mean		2.96	0.10	891,776	899	339.23		41,428	
Standard deviation		0.234	0.004	70,464	8.8	185		524	
95% confidence level *(1.96 * Std.dev.)*		0.460	0.007	138,109	17.2	363		1,027	
Sum	2,430								29,285
Limits acc. to consistency check									
Lower limit					810	0.00		35,807	
Upper limit						899.73		46,356	
			Correction factors resulting from QAL2			0.9700		1.0200	
Campaign emissions	**PE**	*= VSG * NCSG * Oh * 10^{-9}*						t N2O	**33.789**
Emission factor	**EF_n**	*= PE / NAP * 10^{3}*						kg N2O / t HNO3	**1.154**
As a result of this query the mean NCSG value for Project campaign 11 is 339.23 mg N2O / Nm3									
As a result of this query the mean VSG value for Project campaign 11 is 41,428 Nm3 / h									
As a result of this query the result for EFn for Project campaign 11 is 1.15 kg N2O / t HNO3									

Sample calculation for campaign emissions (PE) and Emission factor (EF_n) for the 11th project campaign:

PE [tN_2O] =	41,428[Nm³/h]	*	1.020 [QAL2 factor]	*	339.23 [mg/Nm³]	*	0.970 [QAL2 factor]	*	2,430 [h]	*	10^{-9} =	**33.789 [tN2O]**
EF [kgN2O/tHNO3] =	33.789 [tN2O]	/	29,285 [tHNO3]	*	10^{3} = **1.154 [kgN2O/tHNO3]**							

Note that small deviations occur due to rounding. Please refer to the calculation excel file for details.

N.DBMS Project Campaign Calculatio	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	; 04.01.2012 - 11.03.2012		
Project campaign 12	**Q6: Q2 + confidence levels**					236		240	232
Parameter	**OH**	**AFR**	**AIFR**	**Oph**	**OTh**	**NCSG**		**VSG**	**NAP**
Unit	h	t NH3 / h	ratio	Pa	°C	mg N2O / Nm3		Nm3 / h	t HNO3
Count						1,019		1,021	
Remaining share of data sets									
Minimum		1.052	0.06	305,814	813	99		36,026	
Maximum		3.27	0.10	910,628	902	803		43,405	
Mean		2.95	0.09	889,639	899	212.57		40,463	
Standard deviation		0.197	0.003	57,423	7.1	75		589	
95% confidence level *(1.96 * Std.dev.)*		0.385	0.005	112,548	13.8	147		1,155	
Sum	1,048								12,706
Limits acc. to consistency check									
Lower limit					810	0.00		35,865	
Upper limit						870.36		44,409	
			Correction factors resulting from QAL2			0.9700		1.0200	
Campaign emissions	**PE**		*= VSG * NCSG * Oh * 10^-9^*					t N2O	**8.918**
Emission factor	**EF_n**		*= PE / NAP * 10^3^*					kg N2O / t HNO3	**0.702**
As a result of this query the mean NCSG value for Project campaign 12 is 212.57 mg N2O / Nm3									
As a result of this query the mean VSG value for Project campaign 12 is 40,463 Nm3 / h									
As a result of this query the result for EFn for Project campaign 12 is 0.7 kg N2O / t HNO3									

Sample calculation for campaign emissions (PE) and Emission factor (EF_n) for the 12th project campaign:

PE [tN_2O] =	40,463[Nm³/h]	*	1.020 [QAL2 factor]	*	212.57 [mg/Nm³]	*	0.970 [QAL2 factor]	*	1,048 [h]	*	10^{-9} =	**8.918 [tN2O]**
EF [kgN2O/tHNO3] =	8.918 [tN2O]	/	12,706 [tHNO3]	*	10^3 =	**0.702 [kgN2O/tHNO3]**						

Note that small deviations occur due to rounding. Please refer to the calculation excel file for details.

Relevant Project Emissions (PE_n) and respective Project Emission Factors (EF_n)

The resulting project emissions (PE_n) and project emission factor (EF_n) for the project campaign covered by this monitoring report are:

Campaign	PE	EF_n
11th Project Campaign	33.789 tN_2O	1.154 $kgN_2O/tHNO_3$
12th Project Campaign	8.918 tN_2O	0.702 $kgN_2O/tHNO_3$

Project Campaign Length

If the length of each individual project campaign CL_n is longer than or equal to the average historic campaign length CL_{normal} or to the baseline campaign length whichever is shorter, then all N_2O values measured during the baseline campaign can be used for the calculation of EF (subject to the elimination of data from the operational limits analysis, see above under recalculation of Baseline Emission factor).

For the project campaign 11 the CL_n is longer than CL_{BL}, therefore no adjustment of the Baseline emissions factor EF_{BL} is necessary.

For the project campaign 12 $CL_n < CL_{normal}$ and $CL_n < CL_{BL}$, EF_{BL} is recalculated by eliminating those N_2O values that were obtained during the production of tonnes of nitric acid beyond the CL_{BL} (i.e. the last tonnes produced) from the calculation of EF_{BL}. This was the case at 20/10/2007 09:00 therefore all N_2O data measured after this hour were excluded for the recalculation of EF_{BL}.

As a result of this recalculation the new EF_{BL} to be applied for this project campaign is 5.46 $kgN_2O/tHNO_3$

E.3. Calculation of leakage

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No leakage occurs under this project type.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

Emission reductions

A ***moving average emissions factor*** must be calculated at the end of a campaign n as follows:

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

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

To calculate the total emission reductions achieved in a campaign according to the 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 $EF_p = EF_n$

In addition a campaign-specific ***minimum emissions factor*** (EF_{min}) shall 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 emission factor (EF_{min}). If any of the later project campaigns results in an EF_n that is lower than EF_{min}, the calculation of the emission reductions for that particular campaign shall use EF_{min} and not EF_n.

The minimum emissions factor for the first 10 project campaigns was 0.27 $kgN_2O/ tHNO_3$. It was established during the Project campaign 8.

The emission reductions for the project activity during this monitoring period 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 according to:

$ER = (EF_{BL} – EF_P) * NAP * 10^{-3} * GWP\_N_2O\ (tCO_2e)$

Sample calculation of emission reductions:

11^{th} PC: ER [tCO_2e] =	(5.640	-	1.300)	[kg N_2O/t HNO_3]	*	29,285	[t HNO_3]	* 10^{-3} * 310 =	**39,402** **[tCO2e]**

12^{th} PC: ER [tCO_2e] =	(5.458	-	1.250)	[kg N_2O/t HNO_3]	*	12,706	[t HNO_3]	* 10^{-3} * 310 =	**16,574** **[tCO2e]**

Note that small deviations occur due to rounding. Please refer to the calculation excel file for details. The final result is rounded down.

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.
EF_{BL}	Baseline emissions factor ($kgN_2O/tHNO_3$)
EF_P	Emissions factor used to calculate the emissions from this particular campaign (i.e. the higher of $EF_{ma,n}$ and EF_n) ($kgN_2O/tHNO_3$)
GWP_{N2O}	Global Warming Potential of N_2O (310 tCO_2e/tN_2O)

The resulting emission reductions (ER) for each of the project campaigns covered by this monitoring report and all relevant monitoring results are summarized in the table below:

		Project campaign 11 (PC11): 26/07/2011 - 18/12/2011	Project campaign 12 (PC12): 04/01/2012 - 11/03/2012
$NCSG_{BL}$	mg/Nm³	1,764.44	1,707.48
QAL2 NCSG		0.97	0.97
VSG_{BL}	Nm³/h	42,983	42,983
QAL2 VSG		0.962	0.962
OH_{BL}	h	1,474	1,474
NAP_{BL}	t HNO_3	17,718	17,718
BE	t N_2O	104.315	100.947
UNC		4.20	4.20
EF_{BL}	**kg N_2O/t HNO_3**	**5.64**	**5.46**
$NCSG_n$	mg/Nm³	339.23	212.57
QAL2 NCSG		0.97	0.97
VSG_n	Nm³/h	41,428	40,463
QAL2 VSG		1.020	1.020
OH_n	h	2,430	1,048
NAP_n	t HNO_3	29,285	12,706
PE_n	t N_2O	33.789	8.918
EF_n	kg N_2O/t HNO_3	1.15	0.70
$EF_{ma,n}$	kg N_2O/t HNO_3	1.30	1.25
EF_{min}	kg N_2O/t HNO_3	0.27	0.27
EF_p	**kg N_2O/t HNO_3**	**1.30**	**1.25**
GWP	tCO_2e/tN_2O	310.00	310.00
ER	**tCO_2e**	**39,402**	**16,574**
Total ER for the monitoring period		**55,976**	

Summary of calculation of emission reductions

Time Period	Baseline emissions or baseline net GHG removals by sinks	Project emissions or actual net GHG removals by sinks	Leakage	Emission reductions or net anthropogenic GHG removals by sinks
	(tCO_2e)	(tCO_2e)	(tCO_2e)	(tCO_2e)
Project campaign 11	51,204.43	11,802.03	0	39,402.40
				rounded: 39,402
Project campaign 12	21,498.61	4,924.18	0	16,754.43
				rounded: 16,574
Total				55,976

This monitoring period consists of two production campaigns. The calculation of emission reductions is done for each campaign and the table above depicts the sum of both campaigns. The result of each calculation is rounded down for reasons of conservativeness.

It should be noted that AM0034 requires calculating emission reductions by establishing product related baseline and project emission factors and multiplying the difference with the nitric acid production. The baseline emissions and the project emissions stated in the summary of calculations above have been

calculated only for the purpose of this table since the calculation of Baseline emissions and Project emissions are not foreseen in AM0034. However, the calculated values are correct besides the rounding issue described above. The values have been calculated by using the following formula:

Campaign 11:
Baseline Emissions (BE) = EF_{BL} * NAP_{11} * GWP * 10^{-3}= 5.640 * 29,285*310 / 10^3 = 51,204.43
Project Emissions (PE) = EF_{P11} * NAP_{11} * GWP * 10^{-3}= 1.300 * 29,285*310 / 10^3 = 11,802.03
Emission Reductions = BE – PE = 51,204.43 – 11,802.03 = 39,402.40 (**39,402** CERs claimed due to rounding in calculation)

Campaign 12:
Baseline Emissions (BE) = EF_{BL} * NAP_{12} * GWP * 10^{3}= 5.458 * 12,706*310 / 10^3 = 21,498.61
Project Emissions (PE) = EF_{P12} * NAP_{12} * GWP * 10^{-3}= 1.25 * 12,706*310 / 10^3 = 4,924.18
Emission Reductions = BE – PE = 21,498.61 – 4,924.18 = 16,574.43 (**16,574** CERs claimed due to rounding in calculation)

Comparison of design capacity and actually achieved production during this monitoring period

The design capacity of the plant is 292.112 metric tonnes per day, operating 365 days per year. This equals a total production of 70,399 tonnes for a period of 241 days. Therefore the factual production of 41,991 tonnes during this monitoring period is below the design capacity of the plant.

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (tCO_2e)	77,106 (calculated for a monitoring period of 241 days)	55,976 (during the monitoring period of 241 days)

E.6. Remarks on difference from estimated value in registered PDD

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Not applicable as the actual GHG emission reductions achieved during this monitoring period are below the values estimated in ex-ante calculation of the registered PDD.

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History of the document

Version	Date	Nature of revision
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	EB 54, Annex 34 28 May 2010	Initial adoption.
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