

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

Title of the project activity	N2O ABATEMENT PROJECT AT NITRIC ACID PLANT NO. 11 AT AFRICAN EXPLOSIVES LTD. (AEL), SOUTH AFRICA
Reference number of the project activity	1364
Version number of the monitoring report	02
Completion date of the monitoring report	07/08/2012
Registration date of the project activity	08/02/2008
Monitoring period number and duration of this monitoring period	- Number 5 - 07/08/2011 – 17/04/2012, 255 days
Project participant(s)	- African Explosives Ltd - N.serve Environmental Services GmbH - Electrabel NV/SA
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	185,458 tCO ₂ e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	174,490 tCO ₂ e

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 N₂O emissions from the production of nitric acid at AEL's nitric acid plant No. 11 ("AEL-11") in Modderfontein, South Africa, by implementation of a secondary N₂O abatement catalyst.

Brief description of the installed technology and equipments

The employed secondary N₂O abatement catalyst technology is supplied by Yara International ASA. Continuous monitoring of emission reductions is assured by an Automated Measuring System (AMS), consisting of stack gas volume flow meter, N₂O Analyzer, 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: 08/02/2008

Installation of AMS: January 2006 (The N₂O analyser was replaced in September 2007, after the baseline measurement). Because of some technical difficulties with the Environnement MIR9000 analyser on the No. 9 plant, AEL has decided to install two completely new analysers (ABB Uras 14) in both the No. 9 and the No. 11 plant in 2007.)

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. 11 nitric acid plant were used to derive these normal ranges. See section D.1. for details.

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:

Campaign	Start date	End date	In-/Excluded
C10	29/05/2003	24/11/2003	Included
C12	27/05/2004	12/12/2004	Included
C13	15/12/2004	24/07/2005	Included
C14	27/07/2005	28/01/2006	Included
C15	03/02/2006	31/07/2006	Included

Baseline Campaign: BL – Campaign 20/07/2006 – 18/02/2007

Intermediate Campaign

Without secondary catalyst: 25/02/2007 – 18/08/2007

Installation of secondary catalyst: 12/09/2007

Starting Date of Crediting period: 08/02/2008

Project Campaigns completed prior to current monitoring period:



1. Campaign	PC1 - 12/09/2007-19/03/2008
2. Campaign	PC2 - 20/03/2008-28/09/2008
3. Campaign	PC3 - 04/10/2008-23/05/2009
4. Campaign	PC4 - 08/06/2009-27/12/2009
5. Campaign	PC5 - 30/12/2009-03/08/2010
6. Campaign	PC6 - 04/08/2010-16/11/2010
7. Campaign	PC7 - 19/11/2010-28/02/2011
8. Campaign	PC8 - 24/03/2011-06/08/2011

Project Campaigns covered by current Monitoring/Verification Period:

9. Campaign	PC9 – 22/08/2011-17/04/2012
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Total emission reductions achieved in this monitoring period

The total amount of emission reductions achieved in this monitoring period is 174,490 t CO₂e.

A.2. Location of project activity

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Host Party: South Africa

Region/State/Province: Gauteng / Modderfontein

City/Town/Community: City of Johannesburg

Physical/Geographical location: 26°05'50'' South, 28°10'26'' 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
United Kingdom of Great Britain and Northern Ireland	Electrabel NV/SA	No
Switzerland	N.serve Environmental Services GmbH	No
Switzerland	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
(http://cdm.unfccc.int/filestorage/C/D/M/CDMWF_AM_HPMLB4XF5J1FZQGG1QSBKMKZSB_C570/EB27_repan05_AM0034_ver02.pdf?t=T2V8bTV4MTElfDBiA2pXdOnYLJ-ocyQr664K)

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: 08/02/2008

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:

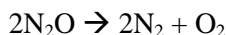
- 1.) secondary N₂O abatement technology
- 2.) Automated Monitoring System (AMS) for continuous N₂O measurement which is fully in compliance with European Standard EN 14181 (see Section C for more detail)
- 3.) training of local staff on installation, operation and maintenance of catalyst and monitoring 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 has contracted with Johnson Matthey plc to install the YARA 58 Y 1® catalyst system consisting of an additional base metal catalyst that is installed below the standard precious metal gauze pack. This technology has been implemented inside the AEL-11 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 W.C. Heraeus. for a number of years. The precious metal composition of that gauze pack remains unchanged during the crediting period of the project.

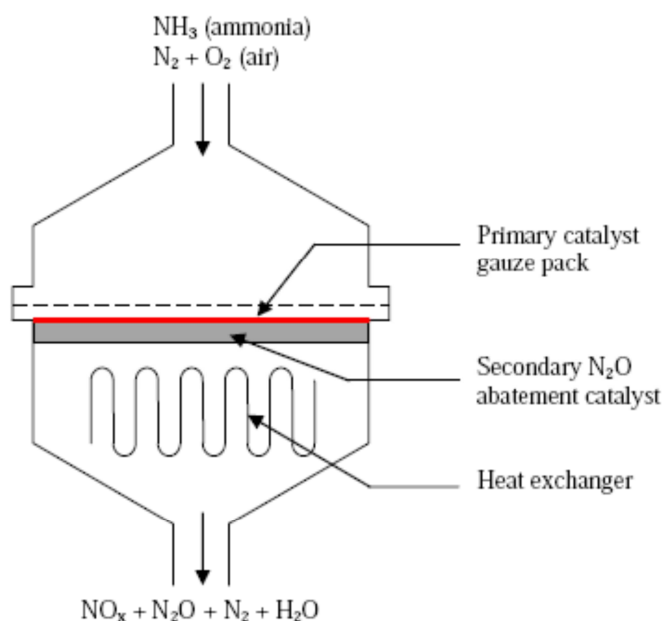
A secondary catalyst will reduce N₂O levels in the gas mix resulting from the primary ammonia oxidation reaction. A wide range of metals (e.g. Cu, Fe, Mn, Co and Ni) have shown to be of varied effectiveness in N₂O abatement catalysts. The YARA 58 Y 1® abatement catalyst is made of cylindrical pellets containing cobalt as an active ingredient. The catalyst has been tried and tested in a number of nitric acid plants in Europe. The abatement efficiency has been shown to be up to 90 80% in the following reaction:



If operated properly, the secondary catalyst system has a lifetime of several campaigns and may reduce N₂O emissions to a level satisfactorily below the baseline for about two years, before the catalyst material needs to be replaced. The YARA 58 Y 1® abatement catalyst does not contaminate the nitric acid produced in the respective nitric acid plant, neither with Cobalt nor with any of the other catalyst materials. It does not require additional heat or other energy input, because the temperature levels present inside the Ammonia Oxidation Reactor suffice to ensure its optimum abatement efficiency. There are no additional greenhouse gases or other emissions generated by the reactions at the N₂O abatement catalyst.

N₂O 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.11 operates at a pressure of around 4.5 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 20/07/2006 until 18/02/2007.

The secondary catalyst was installed on the 12/09/2007, which is the starting date of the project activity. The project got registered by UNFCCC on the 08/02/2008, 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	
	07/08/2011	22/08/2011			Plant shut down for maintenance
1	22/08/2011 21:00		C25	PC9	New campaign start with fresh primary gauze, start of project campaign 9
2	26/08/2011 14:00	26/08/2011 23:00	C25	PC9	Plant tripped on high absorption column level.
3	14/09/2011 01:00	14/09/2011 14:00	C25	PC9	Plant trip due to power dip.
4	23/09/2011 23:00	24/09/2011 04:00	C25	PC9	Plant trip due to power failure
5	24/09/2011 13:00	28/09/2011 12:00	C25	PC9	Leakage in gas sampling line causing some fluctuations of the analyzer readings and dilution of the sample gas with some ambient air. The N ₂ O results were excluded from the calculation of emission reductions.
6	22/10/2011 08:00	23/10/2011 01:00	C25	PC9	Tripped due to low instrument air.
7	03/12/2011 22:00	04/12/2011 05:00	C25	PC9	Plant tripped due to ammonia/air ratio
8	08/12/2011 11:00	11/12/2011 20:00	C25	PC9	Plant shutdown to inspect converter; Maintenance and basket repairs
9	01/03/2012 12:00	01/03/2012 18:00	C25	PC9	Instrument air failure
10	17/04/2012 20:00		C25	PC9	Shut down for maintenance and gauze change -End of campaign

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.

No events or incidents that resulted in AMS downtime occurred during this second monitoring period or during the baseline campaign period. Per AM0034 no correction is needed for the plant downtime periods.

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 N₂O at the stack of AELs No.11 nitric acid plant was installed and has been operated since January 2006. The Manufacturer and type of the first N₂O Analyser was Environnement S.A. MIR 9000. After the measurements for the baseline campaign were completed it was replaced by an ABB AO2040 Uras 14 NDIR analyser in 2007. Because of some technical difficulties with the Environnement MIR9000 analyser on the No. 9 plant, AEL has decided to install two completely new analysers (ABB Uras 14) in both the No. 9 and the No. 11 plant in 2007.

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 is in 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 analyzer the gas is treated by a dryer unit to avoid possible moisture effects.

4. Analyser

NCSG measurements: Environnement S.A. MIR 9000 (during baseline Campaign), ABB AO2040 Uras 14 during project campaigns.

5. Flow Meter

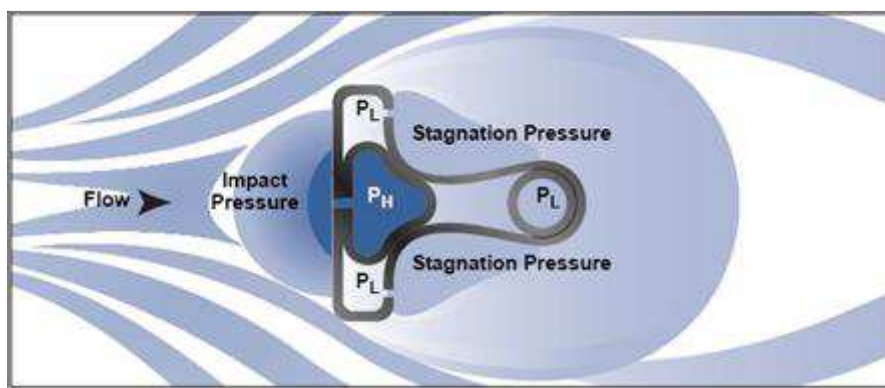
The Emerson Rosemount Flow Meter Annubar®, model no. 485, relies on the Averaging Pilot Tubes (APTs).

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 monitoring methodology AM0034 (Version 2) as prepared by N.serve Environmental Services GmbH. It is the appropriate monitoring methodology to be used in conjunction with the baseline methodology AM0034, "Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants". Its applicability depends on the same prerequisites as the mentioned baseline methodology.

AM0034 requires the use of the European Standard EN14181 (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 N₂O emissions.

As an operator of the nitric acid plants since 1932 and of the No. 11 nitric acid plant since 1979, 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 ongoing 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 to see if there are 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. Albrecht von Ruffer, Managing Director of 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. 11 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.

At the time of purchasing of the AMS by AEL, no AMS vendors had yet conducted the QAL 1 suitability testing for N₂O and it was not known if any vendors were in the process of obtaining this. The chosen gas analyser MIR9000 from Environnement however, has passed the QAL1 suitability for measurements of NO_x and other gaseous emissions. In addition QAL1 tests for N₂O were successfully performed in 2007 by an independent 3rd party testing laboratory with EN ISO/IEC 17025 accreditation. The Environnement S.A. MIR9000 analyser was used during the baseline campaign. Before start of the first project campaign it was replaced by 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 certified¹ 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 SO₂. At the time of commissioning of the AMS by AEL no AMS was available that had been certified according with EN 14181 QAL1 for N₂O measurements. However, ABB has conducted and successfully completed the QAL1 tests² for the follow-up model of this analyser module within the same analyser series (ABB AO2040 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. 11 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

¹ TÜV Süddeutschland Bau und Betrieb GmbH (Report number 170 608), March 2003

² TÜV Süd Industrie Service GmbH, München (Report number 821029) June 2006

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 then evaluated against the required uncertainty. According to EN14181, 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 N₂O analyzer is calibrated once per year by external QAL2 or AST 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 analyzer, 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 N₂O Calibration gas (balance being N₂) with a precision of $\pm 2\%$ 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 according to EN 14181. In addition the flow meter is calibrated at least once per year (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 device 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.

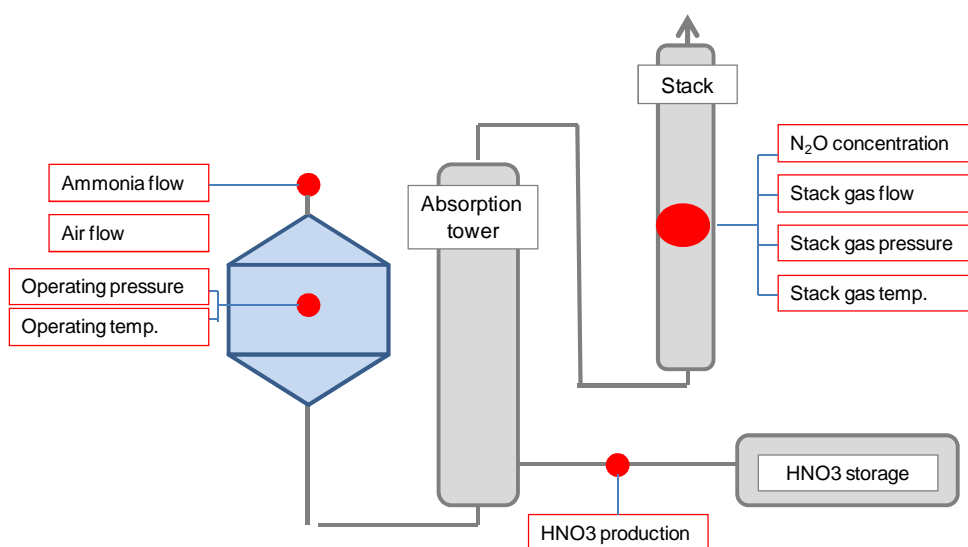


Figure: Monitoring Points for all relevant Parameters (NCSG, VSG, TSG, PSG, NAP, OTh, OPh, AFR, AIFR)

Training

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 weeks 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}³
Unit	mg/Nm³
Description	N ₂ O concentration in the stack gas during the baseline campaign.
Source of data	NDIR N ₂ O gas analyser (Environnement S.A. MIR 9000)
Value(s) applied	Value applicable for regular project campaigns exceeding CL _{normal} or CL _{BL} : 1,630.03 Value applicable for Project Campaign 9: 1,630.03
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 ₂ O concentration in the stack. As a result from the QAL2 calibration curve, it was determined that a correction factor of 1.104 has to be applied to all NCSG measurements. Therefore, the mean NCSG value will be multiplied by 1.104 before going into the calculation of BE _{BC} . Calibration information During Baseline period 20/07/2006 – 18/02/2007: Bi-weekly Zero and span check and calibration in case of deviation >1% of range of analyzer 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: 18/07/2006 During the baseline period: check performed twice per week Last check for baseline period: 17/02/2007 Next check after baseline period: 20/02/2007 Date of last external calibration: QAL2 Test – 01/08/2007 - 04/08/2007 valid until August 2012 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.2 VSG_{BC}
Unit	Nm³/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
Value(s) applied	72,468
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

³ 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.



	<p>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.</p> <p>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 1.01 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 1.01 before going into the calculation of BE_{BC}.</p> <p>Calibration information During Baseline period 20/07/2006 – 18/02/2007</p> <p>Internal calibrations: after each campaign Date of internal calibration :19/07/2006 Date of internal calibration :23/02/2007</p> <p>Date of last external calibration: QAL2 Test – 01/08/2007 - 04/08/2007 valid until August 2012 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.</p>
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Data/Parameter	B.3 BE_{BC}
Unit	tN₂O
Description	Total N ₂ O 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} : 651.983 Value applicable for Project Campaign 9: 651.983
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	4,950
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None



Data/Parameter	B.5 NAP_{BC}
Unit	tHNO₃
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 300 Laboratory results for verification purposes
Value(s) applied	134,700
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 20/07/2006 – 18/02/2007: External calibration by: ALPRET Controls Specialists Date 25/04/2006 and 06/09/2007; 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 situated directly next to the volume 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 Calibration information During Baseline period 20/07/2006 – 18/02/2007 Internal calibrations: after each campaign Date of internal calibration :19/07/2006 Date of internal calibration :23/02/2007 Date of last external calibration: QAL2 Test – 01/08/2007 - 04/08/2007 valid until August 2012

Data/Parameter	B.7 PSG
Unit	Pa (absolute)
Description	Pressure in the stack
Source of data	Stack pressure probe situated directly next to 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 Calibration information During Baseline period 20/07/2006 – 18/02/2007 Internal calibrations: after each campaign



	Date of internal calibration :19/07/2006 Date of internal calibration :23/02/2007 Date of last external calibration: QAL2 Test – 01/08/2007 - 04/08/2007 valid until August 2012
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Data/Parameter	B.8 EF_{BL}
Unit	tN₂O / tHNO₃
Description	Emissions factor for baseline period
Source of data	Calculated from measured data (tons of N ₂ O emitted / tons of nitric acid produced)
Value(s) applied	Value applicable for regular project campaigns exceeding CL _{normal} or CL _{BL} : 0.004647 Value applicable for Project Campaign 9: 0.004647
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	3.99
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

Data/Parameter	B.10 AFR
Unit	tNH₃/h (converted from originally measured Nm³/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 20/07/2006 – 18/02/2007 Calibration frequency: Once every six months. (only during plant shutdown between campaigns) Date of last calibrations: 31/05/2006, 01/11/2006: 19/02/2007

Data/Parameter	B.11 AFR_{max}
Unit	tNH₃/h (converted from originally measured Nm³/h)
Description	Maximum Ammonia gas flow rate to the ammonia oxidation reactor
Source of data	AFR data
Value(s) applied	9.094
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None



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 20/07/2006 – 18/02/2007 Calibration frequency: Once every six months. (only during plant shutdown between campaigns) Date of last calibrations: 31/05/2006, 01/11/2006: 19/02/2007

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	134,700
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 ₂ O 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	127,302.4
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

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
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 20/07/2006 – 18/02/2007 Calibration frequency: Once every six months, validity 8 month (only during plant shutdown between campaigns) Date of last calibrations: 17/08/2006, 14/03/2007

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. 11 nitric acid plant (Technical Manual (TM4 June 1977, p. 250) ⁴ .
Value(s) applied	820 to 905
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 20/07/2006 – 18/02/2007 Calibration frequency: Once every six months. (only during plant shutdown between campaigns) Date of last calibrations: 31/05/2006, 01/11/2006; 19/02/2007

Data/Parameter	B.19 OP_{normal}
Unit	kPa (gauge) min and max
Description	Normal range of operating pressure in the ammonia oxidation reactor
Source of data	Design specifications and operating manual of the No. 11 nitric acid plant (Drawing No. D31 113-4, Sheet 2, December 1977; Operating Instructions No. M69.0300.2008, 1978; No 11 Plant Understanding, p. 10).
Value(s) applied	365 – 450
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	None

⁴ Copies of the technical plant manuals can be provided to the DOE upon request.



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) 56.5%; Rhodium (Rh) 3.8%; Palladium (Pd) 39.7% Record of Gauze compositions installed during the historic campaigns ⁵ : <table><tr><th rowspan="2">Campaign</th><th rowspan="2">Gauze Supplier</th><th colspan="3">Gauze Composition</th></tr><tr><th>Pt (%)</th><th>Rh (%)</th><th>Pd (%)</th></tr><tr><td>C10</td><td>Heraeus</td><td>58.3</td><td>3.9</td><td>37.9</td></tr><tr><td>C12</td><td>Heraeus</td><td>56.1</td><td>3.8</td><td>40.1</td></tr><tr><td>C13</td><td>Heraeus</td><td>56.4</td><td>3.8</td><td>39.8</td></tr><tr><td>C14</td><td>Heraeus</td><td>56.1</td><td>3.8</td><td>40.1</td></tr><tr><td>C15</td><td>Heraeus</td><td>55.4</td><td>3.8</td><td>40.8</td></tr><tr><td colspan="2">Average</td><td>56.5</td><td>3.8</td><td>39.7</td></tr></table>					Campaign	Gauze Supplier	Gauze Composition			Pt (%)	Rh (%)	Pd (%)	C10	Heraeus	58.3	3.9	37.9	C12	Heraeus	56.1	3.8	40.1	C13	Heraeus	56.4	3.8	39.8	C14	Heraeus	56.1	3.8	40.1	C15	Heraeus	55.4	3.8	40.8	Average		56.5	3.8	39.7
Campaign	Gauze Supplier	Gauze Composition																																									
		Pt (%)	Rh (%)	Pd (%)																																							
C10	Heraeus	58.3	3.9	37.9																																							
C12	Heraeus	56.1	3.8	40.1																																							
C13	Heraeus	56.4	3.8	39.8																																							
C14	Heraeus	56.1	3.8	40.1																																							
C15	Heraeus	55.4	3.8	40.8																																							
Average		56.5	3.8	39.7																																							
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) 56%; Rhodium (Rh) 3.8%; Palladium (Pd) 40.2%
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	tN₂O/tHNO₃
Description	Emissions cap for N ₂ O 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 ₂ O 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 9: 373.90
Monitoring equipment	<p>Type: <i>ABB AO2040 URAS 14 Continuous Emissions Analyser, non-dispersive infrared analyser</i></p> <p>Measurement accuracy (for N₂O): 2.69%</p> <p>Serial Number: <i>Instrument number 3.346854.7</i></p> <p>Calibration frequency:</p> <ul style="list-style-type: none"> - <i>External calibration: QAL2 every 5 years;</i> - <i>External calibration: AST every year;</i> - <i>Internal calibration: twice per week manual calibration with test gas</i> <p>Date of last external calibration:</p> <p><i>QAL2 Test (including AST) – 22/06/2011 - 25/06/2011 valid until 21/08/2016</i></p>
Measuring/Reading/Recording frequency	Continuously (every 2 seconds)
Calculation method (if applicable)	<p>AM0034 requires the determination of the concentration of N₂O 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 were subjected to the following statistical analysis:</p> <ol style="list-style-type: none"> 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 <p>During the QAL2 reference measurements it was determined that the analyser consistently overestimates the N₂O concentration in the stack. As a result from the QAL2 calibration curve, it was determined that a correction factor of 0.99 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 0.99 before going into the calculation of PE_n.</p>



QA/QC procedures	Bi-weekly zero and span check and calibration in case of deviation >1% of range of analyzer 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 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	Nm³/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
Value(s) of monitored parameter	Value applicable for Project Campaign 9: 78,897
Monitoring equipment	<p>Type: Tail gas flow by differential pressure principle Overall measurement accuracy: 2.84% (<i>per QAL 2 report</i>) Combined uncertainty for the normalized stack gas flow at standard conditions: 2.96% (<i>per QAL 2 report</i>)</p> <p>Serial Number: <i>instrument number N/A</i> Calibration frequency: - <i>External calibration: QAL2 every 5 years;</i> - <i>External calibration: AST every year;</i> - <i>Internal calibrations: after each campaign (usually every 7 month)</i></p> <p>Date of last external calibration: <i>QAL2 Test (including AST) – 06/07/2010 – 08/07/2010 valid until 05/07/2015</i> <i>AST 22/06/2011 – 25/06/2011 valid until 21/06/2012</i></p> <p><i>Date of internal calibrations: 09/03/2011; 10/08/2011, 21/04/2012</i></p>
Measuring/Reading/Recording frequency	Continuously (every 2 seconds).



Calculation method (if applicable)	<p>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).</p> <p>VSG data taken during times when the plant was out of operation were eliminated.</p> <p>The resulting hourly average VSG values are now expressed in Nm³/h as required by AM0034 and where subsequently subjected to the following statistical analysis:</p> <ol style="list-style-type: none"> Calculate the sample mean (x) Calculate the sample standard deviation (s) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation) Eliminate all data that lie outside the 95% confidence interval Calculate the new sample mean from the remaining VSG values <p>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 0.96 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 0.96 before going into the calculation of PE_n.</p>
QA/QC procedures	<p>Internal calibration at least once per year usually every 4 months after each campaign (the plant has to be shut down to conduct calibration) by the Instrument Department of AEL.</p> <p>every 5 years QAL2 test (including AST) according to EN 14181 (External by qualified institute)</p> <p>yearly AST according to EN 14181 (External by qualified institute)</p>
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	



Data/Parameter	PE_n
Unit	tN₂O
Description	Total mass N ₂ O 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 9 : 156.698
Monitoring equipment	Not applicable.
Measuring/Reading/Recording frequency	Not applicable.
Calculation method (if applicable)	$PE_n = VSG * NCSG * 10^{-9} * OH$ <p>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.</p>
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 9: 5,589
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	tHNO₃
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
Value(s) of monitored parameter	Project Campaign 9: 154,842
Monitoring equipment	Emerson coriolis mass flow meter CMF 200 Overall measurement accuracy: $\leq 0.1\%$ Serial Number: 414940 Calibration frequency: every 3 years Date of last calibration, 09/03/2011 valid until 08/03/2014
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 775 metric tonnes per day, operating 365 days per year. This equals a total production of 197,625 tonnes for a period of 255 days. Therefore the factual production of 154,842 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	<p>Type: Rosemont thermocouple, PT100_385 3-wire RTD Overall measurement accuracy: 2.55% (per QAL2 report) Serial Number: <i>instrument number N/A</i> Calibration frequency: - <i>External calibration: QAL2 every 5 years;</i> - <i>External calibration: AST every year;</i> - <i>Internal calibrations: after each campaign (usually every 7 month)</i></p> <p>Date of last external calibration: <i>QAL2 Test (including AST) – 06/07/2010 – 08/07/2010 valid until 05/07/2015</i> <i>AST 22/06/2011 – 25/06/2011 valid until 21/06/2012</i></p> <p><i>Date of internal calibrations: 09/03/2011; 10/08/2011, 21/04/2012</i></p>
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	<p>Internal calibration at least once per year 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.</p> <p>every 5 years QAL2 test (including AST) according to EN 14181 (External by qualified institute)</p> <p>yearly AST according to EN 14181 (External by qualified institute)</p>
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	<p>Type: Rosemont Overall measurement accuracy: 0.7 % (per QAL2 report) Serial Number: <i>instrument number N/A</i> Calibration frequency: - <i>External calibration: QAL2 every 5 years;</i> - <i>External calibration: AST every year;</i> - <i>Internal calibrations: after each campaign (usually every 7 month)</i></p> <p>Date of last external calibration: <i>QAL2 Test (including AST) – 06/07/2010 – 08/07/2010 valid until 05/07/2015</i> <i>AST 22/06/2011 – 25/06/2011 valid until 21/06/2012</i></p> <p><i>Date of internal calibrations: 09/03/2011; 10/08/2011, 21/04/2012</i></p>
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 applied to each hourly mean VSG value. The measurements are taken continuously by a pressure probe inside the stack very close to the stack gas volume flow meter.
QA/QC procedures	
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	



Data/Parameter	EF_n
Unit	tN₂O/tHNO₃
Description	Emissions factor for campaign n.
Measured/Calculated/Default	Calculated.
Source of data	Calculation from total mass N ₂ O emissions of campaign n (PE _n) and total nitric acid production (NAP _n)
Value(s) of monitored parameter	Project Campaign 9: 0.001012
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 ₂ O 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	tN₂O/tHNO₃
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 9: 0.000988
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: $EF_{ma,n} = (EF_1 + EF_2 + \dots + EF_n) / n$ 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	tN₂O/tHNO₃
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 9: 0.001012
Monitoring equipment	Not applicable.
Measuring/Reading/Recording frequency	Not applicable.
Calculation method (if applicable)	<p>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:</p> <p>If EF_{ma,n} > EF_n then EF_p = EF_{ma,n}</p> <p>If EF_{ma,n} < EF_n then EF_p = EF_n</p>
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	tN₂O/tHNO₃
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	n.a.
Monitoring equipment	Not applicable.
Measuring/Reading/Recording frequency	Not applicable.
Calculation method (if applicable)	<p>A campaign-specific emissions factor shall be used to cap any potential long-term trend towards decreasing N₂O 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.</p>
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	tN₂O/tHNO₃
Description	Emissions cap for N ₂ O 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	tHNO₃
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 9: 154,842
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 ₂ O 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 ₂ O 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	



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	<p>Type: Yokogawa Press Tx – pressure transmitter Overall measurement accuracy: 1.7% Serial Number: F576FB671708 Installation location: Compressor floor</p> <p>During project campaigns the calibration of operational parameters is not relevant. However the calibration dates are listed below for information only Calibration frequency: Once every seven months. (only during plant shutdown between campaigns) - Date of last calibration: 09/08/2011; 21/04/2012</p>
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 Type: K310 S/steel Thermocouple Overall measurement accuracy: 1% Serial Number: TP3285-3290 Installation location: reactor During project campaigns the calibration of operational parameters is not relevant. However the calibration dates are listed below for information only Calibration frequency: Once every campaign (only during plant shutdown between campaigns) Date of last calibration: 08/08/2011;21/04/2012
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	kgNH₃/h (converted from originally measured Nm³/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: F570FD073708 During project campaigns the calibration of operational parameters is not relevant. However the calibration dates are listed below for information only Calibration frequency: Once every seven months. (only during plant shutdown between campaigns) Date of last calibration: 09/08/2011; 21/04/2012
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	<p>Equipment for Air Flow-rate to AOR: Type: Yokogawa Orifice plate with D.P. transmitter Overall measurement accuracy: 1,66% Serial Number: F570FD 069708</p> <p>During project campaigns the calibration of operational parameters is not relevant. However the calibration dates are listed below for information only</p> <p>Calibration frequency: Once every six months. (only during plant shutdown between campaigns) Date of last calibration: 09/08/2011; 21/04/2012</p>
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	

Data/Parameter	GC_{project}	
Unit	%	
Description	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.	
Measured/Calculated/Default	Not applicable.	
Source of data	Monitored / Gauze supplier invoices	
Value(s) of monitored parameter		Project campaign 9
	Platinum (Pt)	55.9%
	Rhodium (Rh)	3.8%
	Palladium (Pd)	40.3%
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		

D.3. Implementation of sampling plan

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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

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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 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 the 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.

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. 11 nitric acid plant were used to derive these normal ranges.

Since no historical data were recorded and available, the allowable NH_3 to Air ratio AIFR_{max} was derived from technical plant manuals (controller data sheet).

The parameters $\text{CL}_{\text{normal}}$, $\text{GS}_{\text{normal}}$, $\text{GC}_{\text{normal}}$ and AFR_{max} were derived from the 5 historic campaigns that were defined in the PDD. The 5 campaigns are:

Campaign	Start date	End date	In-/Excluded
C10	29/05/2003	24/11/2003	Included
C12	27/05/2004	12/12/2004	Included
C13	15/12/2004	24/07/2005	Included
C14	27/07/2005	28/01/2006	Included
C15	03/02/2006	31/07/2006	Included

Oxidation temperature (min – max): 820 °C – 905 °C

Oxidation pressure (min – max): 365,000 Pa – 450,000 Pa

Maximum ammonia flow rate: 9.094 t/h

Maximum ammonia to air ratio: 0,115 or 11,5%

$\text{CL}_{\text{normal}}$: 127,302.4 t HNO_3

As Baseline the campaign C16 (20/07/2006 – 18/02/2007) was selected.

Analysis of Baseline campaign data

As the baseline campaign for AEL No. 11 the campaign C16 (20/07/2006 – 18/02/2007) was used.

Analysis of Baseline campaign data

As the baseline campaign for AEL No. 11 the campaign C16 was used. The baseline campaign was in operation in the period 20/07/2006 – 18/02/2007. 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/Nm ³	1,630.03
QAL2 NCSG		1.104
VSG _{BL}	Nm ³ /h	72,468.01
QAL2 VSG		1.01
OH _{BL}	h	4,950.00
NAP _{BL}	t HNO ₃	134,699.80
BE	t N ₂ O	651.98
UNC	%	3.99
EF _{BL}	kgN ₂ O/tHNO ₃	4.647

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 N₂O 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 N₂O 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 9 the CL_n is longer than CL_{BL} , therefore no adjustment of the Baseline emissions factor EF_{BL} is necessary.

Adjustment of Baseline emissions factor due to EF_{reg}

Should N₂O 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 N₂O emission factor shall be EF_{reg} for all calculations.

where:

Variable Definition

EF_{BL} Baseline emissions factor (tN₂O/tHNO₃)

EF_{reg} Emissions level set by newly introduced policies or regulations (tN₂O/tHNO₃).

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 N₂O 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

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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 ₂ O in the stack gas for the project campaign (mgN ₂ O/m ³)
PE _n	Total N ₂ O emissions of the n th project campaign (tN ₂ O)
OH	Is the number of hours of operation in the specific monitoring period (h)

Based on the total N₂O 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 ₂ O/tHNO ₃)
PE _n	Total N ₂ O emissions of the n th project campaign (tN ₂ O or kgN ₂ O)
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.

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 Calculation Project: AEL No. 11, Johannesburg, South Africa Campaign: C 25; 22.08.2011 - 17.04.2012									
Project campaign 9 Query 1: Without parameter limits									
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	5,760	5,760	5,759	5,760	5,760	5,664	5,760		
Minimum		0.00	0.00	0.00	0	0.00	0		
Maximum		8.76	0.4	425,246.0	902	2,417.1	85,351		
Mean		7.78	0.10	386,929.2	893	448.1	76,548		
Standard deviation		1.380	0.04	64,942.49	22	428.0	13,333		
95% confidence level (1.96 * Std.dev.)		2.70	0.07	127,287.28	43	839	26,132		
Sum	5,760								154,842
Limits acc. to consistency check									
Lower limit									
Upper limit									

According to this Query 1, the NAP value of Project campaign 9 is 154,842 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 820°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 Calculation Project: AEL No. 11, Johannesburg, South Africa Campaign: C 25; 22.08.2011 - 17.04.2012								
Project campaign 9 Query 2: With operational limits								
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	5,589	5,589	5,589	5,589	5,589	5,493	5,589	
Remaining share of data sets	97.0%	97.0%	97.0%	97.0%	97.0%	97.0%	97.0%	
Minimum		0.46	0.09	44,180.00	824	116	8,569	
Maximum		8.76	0.11	425,246.0	902	2,417	85,351	
Mean		8.01	0.10	397,884.8	896	460	78,794	
Standard deviation		0.288	0.002	13,812.621	2.5	428	3,375	
95% confidence level (1.96 * Std.dev.)		0.565	0.003	27,072.737	4.9	839	6,615	
Sum	5,589							154,841.6
Limits acc. to consistency check								
Lower limit					820			
Upper limit								

As a result of this query the number of operation hours OH of Project campaign 9 is 5,589 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 Calculation Project: AEL No. 11, Johannesburg, South Africa Campaign: C 25; 22.08.2011 - 17.04.2012								
Project campaign 9 Q6: Q2 + confidence levels								
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						5,128	5,576	
Remaining share of data sets								
Minimum		0.460	0.09	44,180.00	824	116	72,519	
Maximum		8.76	0.11	425,246.0	902	1,299	85,351	
Mean		8.01	0.10	397,884.8	896	373.90	78,897	
Standard deviation		0.288	0.002	13,812.621	2.5	274	2,442	
95% confidence level (1.96 * Std.dev.)		0.565	0.003	27,072.737	4.9	536	4,786	
Sum	5,589							154,842
Limits acc. to consistency check								
Lower limit					820	0.00	72,179	
Upper limit						1,299.08	85,409	
Correction factors resulting from QAL2						0.9900	0.9600	
Campaign emissions	PE	$= VSG * NCSG * Oh * 10^{-9}$					t N2O	156.698
Emission factor	EF_n	$= PE / NAP * 10^3$					kg N2O / t HNO3	1.012

As a result of this query the mean NCSG value for Project campaign 9 is 373.90 mg N2O / Nm3

As a result of this query the mean VSG value for Project campaign 9 is 78,897 Nm3 / h

As a result of this query the result for EFn for Project campaign 9 is 1.012 kg N2O / t HNO3

Sample calculation for campaign emissions (PE) and Emission factor (EF_n) for the 9th project campaign:

PE [tN ₂ O] =	78,897 [Nm ³ /h] * 0.960 [QAL2 factor] * 373.90 [mg/Nm ³] * 0.990 [QAL2 factor] * 5,589 [h] * 10 ⁻⁹ =	156.698 [tN ₂ O]
EF [kgN ₂ O/tHNO ₃] =	156.698 [tN ₂ O] / 154,842 [tHNO ₃] * 10 ³ =	1.012 [kgN ₂ O/tHNO ₃]

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
Project Campaign 9	156.698 tN ₂ O	1.012 kgN ₂ O/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 N₂O 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 9 the CL_n is longer than CL_{BL}, therefore no adjustment of the Baseline emissions factor EF_{BL} is necessary.

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:

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

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 N₂O 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.

Since only 9 project campaigns are completed, the minimum emissionsfactor is not yet established.

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 N₂O according to:

$$ER = (EF_{BL} - EF_P) * NAP * 10^{-3} * GWP_{N_2O} \text{ (tCO}_2\text{e)}$$

Sample calculation of emission reductions:

9 th PC: ER [tCO ₂ e] =	(4.647	-	1.012)	[kg N ₂ O/t HNO ₃]	*	154,842	[t HNO ₃]	*	10 ⁻³ * 310 =	174,490	[tCO₂e]
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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 ₂ e)
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 ₂ O/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 ₂ O/tHNO ₃)
GWP _{N₂O}	Global Warming Potential of N ₂ O (310 tCO ₂ e/tN ₂ O)

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 9 (PC9): 22/08/2011 - 17/04/2012
NCSG _{BL}	mg/Nm ³	1,630.03
QAL2 NCSG		1.104
VSG _{BL}	Nm ³ /h	72,468
QAL2 VSG		1.010
OH _{BL}	h	4,950
NAP _{BL}	t HNO ₃	134,700
BE	t N ₂ O	651.983
UNC		3.99
EF_{BL}	kg N₂O/t HNO₃	4.647
NCSG _n	mg/Nm ³	373.90
QAL2 NCSG		0.99
VSG _n	Nm ³ /h	78,897
QAL2 VSG		0.960
OH _n	h	5,589
NAP _n	t HNO ₃	154,842
PE _n	t N ₂ O	156.698
EF _n	kg N ₂ O/t HNO ₃	1.012
EF _{ma,n}	kg N ₂ O/t HNO ₃	0.988
EF _{min}	kg N ₂ O/t HNO ₃	n/a
EF_p	kg N₂O/t HNO₃	1.012
GWP	tCO ₂ e/tN ₂ O	310.00
ER	tCO₂e	174,490
Total ER for the monitoring period		174,490

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 ₂ e)	(tCO ₂ e)	(tCO ₂ e)	(tCO ₂ e)
Total	223,066.99	48,576.31	0	174,490.68
				rounded: 174,490

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 have been calculated only for the purpose of this table. The calculations are not in line with the methodology. However, the values are correct besides the rounding issue described above. The values have been calculated by using the following formula:

Campaign 9:

Baseline Emissions (BE) = EF_{BL} * NAP₉ * GWP * 10³ = 4.647 * 154,842 * 310 / 10³ = 223,066.99

Project Emissions (PE) = $EF_{p9} * NAP_9 = 0.992 * 154,842 * 310 / 10^3 = 48,576.31$
Emission Reductions = $BE - PE = 223,066.99 - 48,576.31 = 174,490.68$ (**174,490** CERs claimed due to rounding in calculation)

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

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

The design capacity of the plant is 775 metric tonnes per day, operating 365 days per year. This equals a total production of 197,625 tonnes for a period of 255 days. Therefore the factual production of 154,842 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 ₂ e)	185,458 (calculated for a monitoring period of 255 days)	174,490 (during the monitoring period of 255 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.

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.
Decision Class: Regulatory Document Type: Form Business Function: Issuance		