MONITORING REPORT FORM (CDM-MR) *
Version 01 - in effect as of: 28/09/2010

CONTENTS

* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
Version 05; 28/08/2012

TITLE: "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: 1171
Monitoring period: No 03, 05/08/2009 – 01/07/2010

SECTION A. General description of the project activity

A.1. Brief description of the project activity:

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 Heraeus Ltd. Continuous monitoring of emission reductions is assured by an Automated Measuring System (AMS), consisting of stack gas volume flow meter, N_2O 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: 05/11/2007

Installation of AMS: The N_2O Analyzer was installed in May 2007. The stack gas flow meter was installed in June 2006

Baseline Campaign: BL – 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:	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[2]
	4. Campaign	PC4 - 25/02/2009-04/08/2009

Project Campaigns covered by current Monitoring/Verification Period:

	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

Total emission reductions achieved in this monitoring period

The total amount of emission reductions achieved in this monitoring period is 57,345 t CO_2e.

A.2. Project Participants

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

[2] During the second monitoring period four intermediate production campaigns without secondary catalyst were performed in the period 07/08/2008 – 21/02/2009. No emission reductions were achieved during this time.

Name of Party involved (host) indicates a Host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly 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.3. Location of the project activity:

The project activity is located in: Modderfontein (approx. 20 km north-east of Johannesburg). Postal address: PO Modderfontein 1645. Coordinates of the plant are 26°05’26’’ South and 28°10’17’’ East.

A.4. Technical description of the project

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 Heraeus to install its N_2O reduction catalyst (HR-SC) system. The catalyst is made of precious metal coated mini raschig rings (Al_2O_3).

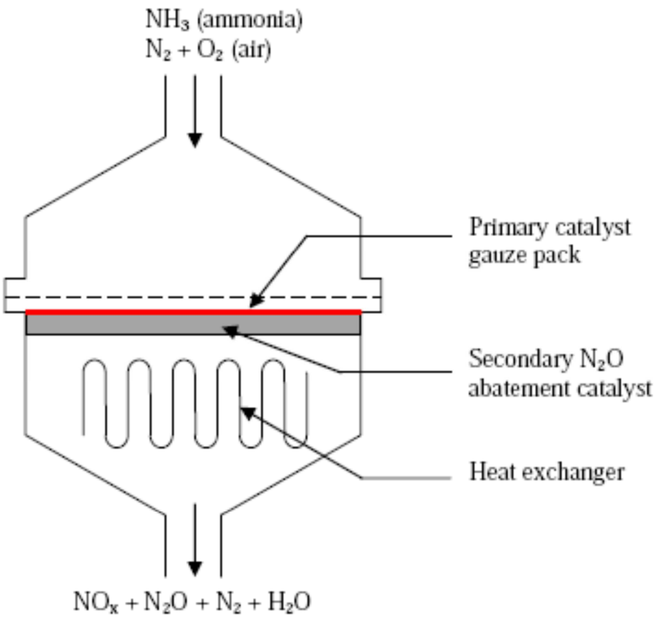
The catalyst does not require additional heat or other energy over and above the temperature that is present inside the Ammonia Oxidation Reactor anyway. There are no additional greenhouse gases or other emissions generated by the reactions at the N_2O abatement catalyst.

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. bar inside the ammonia oxidation reactor.

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

This project activity is based on Approved Baseline and Monitoring methodologies AM0034 (Version 2): "Catalytic reduction of N_2O inside the ammonia burner of nitric acid plants". Furthermore, the project draws on approved baseline methodology AM0028 (Version 04.2) for the baseline scenario selection and employs the "Tool for the demonstration and assessment of additionality" (Version 02).

A.6. Registration date of the project activity:

Registration Date of project activity: 05/11/2007

A.7. Crediting period of the project activity and related information (start date and choice of crediting period):

Crediting period: 10 years; Start date: 05/11/2007

A.8. Name of responsible person(s)/entity(ies):

Contact information of the person(s)/entity(ies) responsible for completing the monitoring report form (CDM-MR).

Mr. Martin Stilkenbäumer (stilkenbaeumer@nserve.net)
Mr. Nikolaus Gutknecht-Stöhr (gutknecht@nserve.net)

N.serve Environmental Services GmbH
Grosse Theaterstrasse 14
20354 Hamburg, Germany

Phone: +49 40 309 97 86-0
Fax: +49 40 309 97 86-10

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

>>

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. Therefore, there are intermediate campaigns between the 5 historic campaigns and 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 was registered by UNFCCC on the 05/11/2007, which is the starting date of the crediting period.
A summary of production campaigns operated in previous monitoring periods as well this monitoring period is given in section A.1. of this monitoring report.
..

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 demonstrate 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	
1	05/08/2009 08:00		H24	5	New campaign start, the layer of secondary catalyst was topped up to improve the abatement performance.
2	07/08/2009 22:00	11/08/2009 11:00	H24	5	NCSG sampling system faulty - results to be replaced by max value
3	24/08/2009 12:00	27/08/2009 09:00	H24	5	NCSG analyzer pump faulty - results to be replaced by max value
4	28/09/2009 08:00	06/10/2009 06:00	H24	5	Plant stop: steam turbine vibrations
5	22/10/2009 22:00	23/10/2009 21:00	H24	5	Tripped due to lightning
6	29/10/2009 12:00	29/10/2009 16:00	H24	5	Plant Stop
7	01/11/2009 09:00		H24	5	End of campaign
8	30/11/2009 17:00		H25	6	Start of new campaign
9	03/12/2009 10:00	29/12/2009 00:00	H25	6	Plant stop
10	01/01/2010 08:00	13/01/2010 06:00	H25	6	Planned shutdown
11	03/03/2010 04:00	06/03/2010 01:00	H25	6	Plant stop

12	07/03/2010		H25	6	End of campaign
13	08/04/2010 20:00		H26	7	Start of new campaign
14	21/04/2010 04:00	22/04/2010 05:00	H26	7	Plant tripped on ratio
15	23/04/2010 10:00	27/04/2010 08:00	H26	7	Shutdown due to low ammonia stock
16	01/05/2010 18:00	12/05/2010 15:00	H26	7	Plant stop
17	13/05/2010 10:00	13/05/2010 14:00	H26	7	NCSG analyzer pump faulty - results to be replaced by max value
18	18/05/2010 18:00	31/05/2010 08:00	H26	7	Shutdown due to Ammonia evaporator leaking
19	04/06/2010 22:00	14/06/2010 21:00	H26	7	Shutdown due to low ammonia stock
20	18/06/2010 10:00	22/06/2010 01:00	H26	7	Shutdown Converter leaking
21	23/06/2010 18:00	29/06/2010 05:00	H26	7	Plant stop
22	01/07/2010		H26	7	End of campaign

NO 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 the baseline campaign period.

Besides the events as described in the table above, no other events or incidents that resulted in AMS downtime occurred during this monitoring. In the case of AMS downtime the missing values were replaced by the maximum values measured during that campaign.

B.2. Revision of the monitoring plan

>>

The monitoring plan has not been revised.

B.3. Request for deviation applied to this monitoring period

>>

No deviation was applied to this monitoring period.

B.4. Notification or request of approval of changes

>>

No notifications or request of approval of changes from the project activity as described in the registered CDM-PDD have been made.

SECTION C. Description of the monitoring system

>>

1. General Description of the AMS

A complete Automated Monitoring System (AMS) to monitor the mass emissions of N_2O at the stack of AEL´s No. 9 nitric acid plant was installed and has been operated since 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 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

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. Flow Meter

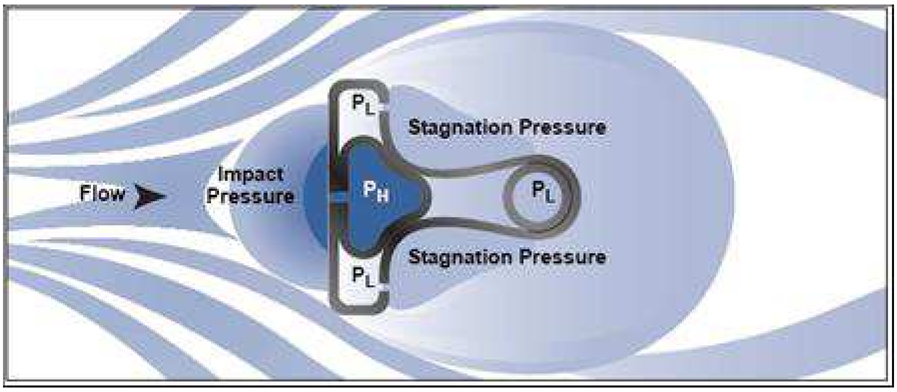
The Emerson Rosemount Flow Meter Annubar®, model no. 485, relies on the Averaging Pitot Tubes (APTs).

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 (hereafter "N.serve"). 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 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 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 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. 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 and 3 have been practically applied at AEL No. 9 plant. QAL 3 procedures are described in section 9 below.

QAL1

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[3] as meeting the requirements (QAL1) of the German emissions standards 17th BImSchV and 13th BImSchV (waste

---

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

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 in accordance with EN 14181 by use of the QAL1 procedure as specified by EN ISO 14956 for N_2O measurements. However, TÜV SÜD conducted and successfully completed the QAL1 tests[4] 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. 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 QAL1 which is conducted off-site). QAL2 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 EN 14181, both the QAL2 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.

A series of QAL2 specific reference measurements using a the SRM method as per EN 14181 has been carried out at the plant for the above mentioned N_2O analyser and stack gas flow meterby an accredited testing house (TÜV SÜD Industrie Service GmbH, Germany) to ensure the AMS' suitability, establish the calibration curve and test the variability of the measurements. The results of these SRM are available to the DOE as part of the verification process. The AMS calibration function as well as the total uncertainty of the AMS was determined. The results were applied in the calculation of EF_{BL} and EF_n. Moreover the overall uncertainty of the AMS was defined in the QAL2 test and was applied to the calculation of the baseline emission factor in a conservative manner (the baseline emission factor was reduced by the AMS uncertainty).

An annual surveillance test (AST) is used 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.

According to the monitoring plan in the PDD it is not necessary to perform an AST by an accredited independent third party. Instead regular QAL3 procedures as periodic zero and span calibrations, checks of the analyser system and maintenance of the AMS are performed. However in addition to these calibrations, AEL decided to perform an AST test. At 10/06/2009 – 11/06/2009 and at 06/07/2010 an Annual Surveillance Tests (AST) has been successfully performed by an accredited testing house. The test was performed in accordance with EN 14181. The AST test confirmed that the calibration function as determined during QAL2 is still valid and that the requirements for variability are fulfilled.

In order to adhere the guidelines for assessing compliance with the calibration frequency requirements as stipulated in EB 52 annex 60 the maximum permissible error of the instruments for NCSG and VSG was applied. The error was applied in a conservative manner for the period between the scheduled AST test and the actual date of the AST test. The error was applied for the period from 10/06/2010 to 01/07/2010 (end of this monitoring period). **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.

---

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

QAL3

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 analyzer is calibrated once per year by external 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 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 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).

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 AST test according to EN 14181. In addition the flow meter is calibrated at least once per year (which is usually done every 4 month - after each campaign as 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.

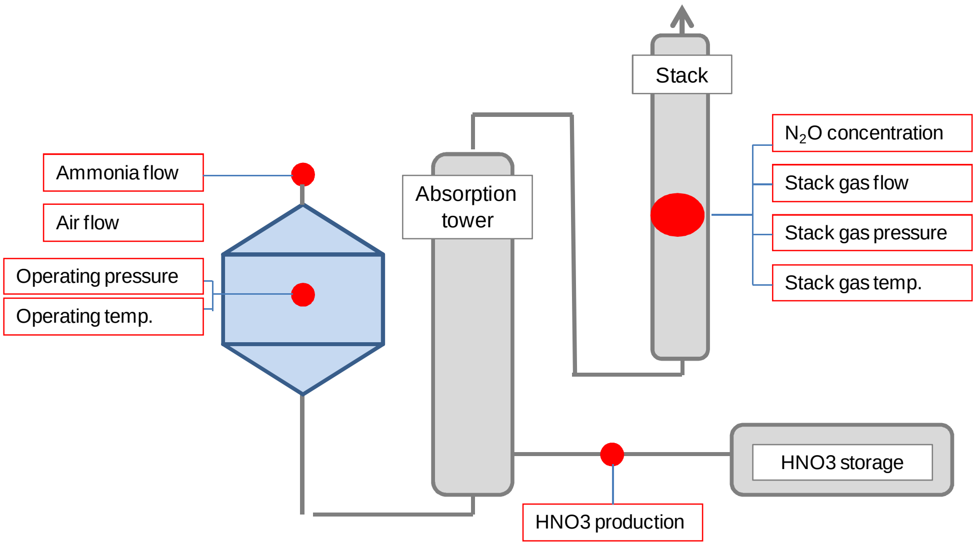


Figure: Monitoring Points for all relevant Parameters (NCSG, VSG, TSG, PSG, NAP, OT_h, OP_h, AFR, AIFR)

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 are sent to N.serve on a regular basis (e. g. after each campaign) where they are 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 determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	**B.1 $NCSG_{BC}$**
Data unit:	**mg/Nm^3**
Description:	N_2O concentration in the stack gas during the baseline campaign.
Source of data used:	ABB AO2040 URAS 14 Continuous Emissions Analyser
Value(s) :	Value applicable for **regular project campaigns** exceeding CL_{normal} or CL_{BL}: **1,764.44** Value applicable for Project Campaign 5: **1,764.44** Value applicable for Project Campaign 6: **1,756.03** Value applicable for Project Campaign 7: **1,635.95**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations
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 have to be 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 analyzer against zero gas and certified calibration gas cylinder (internal calibration by AEL). Documentation in form of calibration reports and Shewart charts. First calibration for baseline period: 04/09/2007 During the baseline period: calibrations performed twice per week Last calibration for baseline period: 05/11/2007 Next calibration after baseline period: 08/11/2007 Date of last external calibration: QAL2 Test – 07/02/2008 - 13/02/2008 valid until 06/02/2013 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.2 VSG_{BC}**
Data unit:	**Nm^3/h**
Description:	Normal gas volume flow rate of the stack gas during the baseline campaign.
Source of data used:	Gas Volume Flow meter, Emerson Rosemount Annubar® Model 485 combined with pressure transmitter Rosemount 3051S
Value(s) :	**42,983**
Indicate what the data are used for (Baseline/	Baseline emission calculations.

Project/ Leakage emission calculations)	
Additional comment:	The QAL2 test as well as the AST 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 and AST tests 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 month) 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 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}**
Data unit:	**tN_2O**
Description:	Total N_2O mass flow during baseline campaign
Source of data used:	Calculation from measured data.
Value(s) :	Value applicable for **regular project campaigns** exceeding CL_{normal} or CL_{BL}: **104.315** Value applicable for Project Campaign 5: **104.315** Value applicable for Project Campaign 6: **103.817** Value applicable for Project Campaign 7: **96.718**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	None

Data / Parameter:	**B.4 OH_{BC}**
Data unit:	**hours**
Description:	Operating hours
Source of data used:	Production log
Value(s) :	**1,474**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	None

Data / Parameter:	**B.5 NAP_{BC}**
Data unit:	**$tHNO_3$**
Description:	Metric tonnes of 100% concentrated nitric acid produced during the baseline campaign.
Source of data used:	Nitric acid flow meter Manufacturer: EMERSON, Type: Coriolis mass flow meter CMF 200 Laboratory results for verification purposes
Value(s) :	**17,718**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
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**
Data unit:	**°C**
Description:	Temperature in the stack gas
Source of data used:	Stack temperature probe as part of the VSG flow meter.
Value(s) :	**Not applicable**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
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 month), 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**
Data unit:	mbar (absolute)
Description:	Pressure in the stack
Source of data used:	Stack pressure as part of the VSG flow meter.
Value(s) :	**Not applicable**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
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 month) 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}**
Data unit:	**tN2O/tHNO3**
Description:	Emissions factor for baseline period
Source of data used:	Calculated from measured data (tons of N_2O emitted / tons of nitric acid produced)
Value(s) :	Value applicable for **regular project campaigns** exceeding CL_{normal} or CL_{BL}: **0.00564** Value applicable for Project Campaign 5: **0.00564** Value applicable for Project Campaign 6: **0.00561** Value applicable for Project Campaign 7: **0.00523**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	None

Data / Parameter:	**B.9 UNC**
Data unit:	**%**
Description:	Calculated overall uncertainty of the Automated Monitoring System (AMS)
Source of data used:	UNC is determined by conducting reference measurements by an independent testing laboratory with EN ISO/IEC 17025 accreditation (QAL2).

Value(s) :	**4.20**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline / Project emission calculations.
Additional comment:	None

Data / Parameter:	**B.10 AFR**
Data unit:	**tNH_3/h**
Description:	Ammonia gas flow rate to the ammonia oxidation reactor
Source of data used:	Differential pressure measurement (orifice plate) Type: D/P
Value(s) :	Not applicable, monitored data of AFR will be used to determine if plant was operating outside of AFR_{max}.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	Calibration information During Baseline period 05/09/2007 – 06/11/2007 : Calibration frequency: Once every six months. (only during plant shutdown between campaigns) Date of last calibrations: 04/09/2007, 10/02/2008

Data / Parameter:	**B.11 AFR_{max}**
Data 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 used:	AFR data
Value(s) :	**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 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.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	None

Table: Maximum NH_3 gas flow to the AOR

Campaign No.	**Start Date**	**End date**	**Total NH_3 consumed**	**Maximum NH_3 consumed per day**
			tonnes	**tonnes**
H6	04/06/2004	16/09/2004	7,448.377	93.131
H7	24/09/2004	27/12/2004	7,372.149	89.508
H8	14/03/2005	21/06/2005	7,828.5427	92.187
H9	23/09/2005	20/12/2005	6,838.168	90.425
H10	17/02/2006	20/07/2006	6,907.924	91.204

Data / Parameter:	**B.12 AIFR**
Data unit:	**% v/v**

Description:	Ammonia to air ratio into the ammonia oxidation reactor
Source of data used:	Measurements of AFR and primary air flow rates (measured by differential pressure measurement).
Value(s) :	**Not applicable, monitored data of AIFR will be used to determine if plant was operating outside of $AIFR_{max}$.**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	Calibration information During Baseline period 05/09/2007 – 06/11/2007 : Calibration frequency: Once every six months. (only during plant shutdown between campaigns) Date of last calibrations: 04/09/2007, 10/02/2008

Data / Parameter:	**B.13 CL_{BL}**
Data unit:	**tHNO3**
Description:	Length of the baseline campaign measured in metric tonnes of 100% concentrated nitric acid produced during that baseline campaign.
Source of data used:	NAP_{BC}
Value(s) :	**17,718**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	None

Data / Parameter:	**B.14 CL_{normal}**
Data unit:	**tHNO3**
Description:	Average length of the historic campaigns measured in metric tonnes of 100% concentrated nitric acid produced during the historic campaigns.
Source of data used:	Flow meter measurements as described in NAP.
Value(s) :	**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.
Indicate what the data	Baseline / Project emission calculations.

Campaign No.	Start Date	End date	Production ($tHNO_3$)
			tonnes
H6	04/06/2004	16/09/2004	24,443.3
H7	24/09/2004	27/12/2004	24,041.6
H8	14/03/2005	21/06/2005	26,945.1
H9	23/09/2005	20/12/2005	24,326.1
H10	17/02/2006	20/07/2006	20,374.6
Mean			**24,026.2**

are used for (Baseline/ Project/ Leakage emission calculations)	
Additional comment:	None

Data / Parameter:	**B. 15 $AIFR_{max}$**
Data unit:	**% v/v**
Description:	Maximum Ammonia to air ratio into the ammonia oxidation reactor.
Source of data used:	AIFR Data
Value(s) :	**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%.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	None

Data / Parameter:	**B.16 OT_h**
Data unit:	**°C**
Description:	Oxidation temperature for each hour during the baseline campaign
Source of data used:	Monitoring results of a thermocouple inside the ammonia oxidation reactor.
Value(s) :	**Not applicable**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	Calibration information During Baseline period 05/09/2007 – 06/11/2007 : Calibration frequency: Once every campaign (only during plant shutdown between campaigns) Date of last calibrations: 04/09/2007, 10/02/2008

Data / Parameter:	**B.17 OT_{normal}**
Data unit:	**°C (min and max)**
Description:	Normal range operating temperature
Source of data used:	Design specifications and operating manual of the No. 9 nitric acid plant (Technical Manual (TM24 June 1977, p94).
Value(s) :	**810 to 915**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	None

Data / Parameter:	**B.18 OP_h**
Data unit:	**kPa (gauge)**
Description:	Oxidation Pressure for each hour during the baseline campaign
Source of data used:	Monitoring results of a pressure transmitter on the ammonia oxidation reactor (ammonia to air mixer).
Value(s) :	**Not applicable.**

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	Calibration information During Baseline period 05/09/2007 – 06/11/2007 : Calibration frequency: Once every six month (only during plant shutdown between campaigns) Date of last calibrations: 04/09/2007, 10/02/2008

Data / Parameter:	**B.19 OP_{normal}**
Data 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 used:	Design specifications and operating manual of the No. 9 nitric acid plant (Technical Manual (TM24 June 1977, p94).
Value(s) :	**860 to 910**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	None

Data / Parameter:	**B.20 GS_{normal}**
Data unit:	**Name of Supplier**
Description:	Gauze supplier for the operating condition (i.e. historic) campaigns
Source of data used:	Monitored / Invoices
Value(s) :	**W.C. Heraeus**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	None

Data / Parameter:	**B.21 GS_{BL}**
Data unit:	**Name of Supplier**
Description:	Gauze supplier for the baseline condition campaign
Source of data used:	Monitored / Invoices
Value(s) :	**W.C. Heraeus**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	None

Data / Parameter:	**B.23 GC_{normal}**
Data 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 used:	Monitored / Gauze supplier invoices
Value(s) :	**Platinum (Pt) 59; Rhodium (Rh) 4; Palladium (Pd) 37**

	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>H6</td><td>Heraeus</td><td>59</td><td>4</td><td>37</td></tr><tr><td>H7</td><td>Heraeus</td><td>59</td><td>4</td><td>37</td></tr><tr><td>H8</td><td>Heraeus</td><td>59</td><td>4</td><td>37</td></tr><tr><td>H9</td><td>Heraeus</td><td>59</td><td>4</td><td>37</td></tr><tr><td>H10</td><td>Heraeus</td><td>59</td><td>4</td><td>37</td></tr><tr><td colspan="2">Average</td><td>59</td><td>4</td><td>37</td></tr></table>
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline emission calculations.
Additional comment:	None

Data / Parameter:	**B.24 GC_{BL}**
Data 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 used:	Monitored / Gauze supplier invoices
Value(s) :	**Platinum (Pt) 59; Rhodium (Rh) 4; Palladium (Pd) 37**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline / Project emission calculations.
Additional comment:	None

Data / Parameter:	**B.26 EF_{reg}**
Data unit:	**$tN_2O/tHNO_3$**
Description:	Emissions cap for N_2O from nitric acid production set by government regulation
Source of data used:	Department of Environmental Affairs and Tourism
Value(s) :	**None**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline / Project emission calculations.
Additional comment:	None.

D.2. Data and parameters monitored

Data / Parameter:	**NCSG**
Data 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	Value applicable for Project Campaign 5: **461.18**

[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.

parameter:	Value applicable for Project Campaign 6: **471.48** Value applicable for Project Campaign 7: **609.86**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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 calibration: twice per week manual calibration with test gas* 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 calibration for monitoring period: 03/08/2009 During the monitoring period: calibrations performed twice per week Last calibration for monitoring period: 01/07/2010 Next calibration after monitoring period: 05/07/2010 Date of last external calibration: *QAL2 Test – 07/02/2008 - 13/02/2008 valid until 06/02/2013* *AST – 10/06/2009 - 11/06/2009 valid until 09/06/2010* *ASTt – 06/07/2010 valid until 05/07/2011*
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 applied:	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) First calibration for monitoring period: 03/08/2009 During the monitoring period: calibrations performed twice per week Last calibration for monitoring period: 01/07/2010 Next calibration after monitoring period: 05/07/2010 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) Calibration delay: In order to adhere the guidelines for assessing compliance with the calibration frequency requirements as stipulated in EB 52 annex 60 the maximum permissible error of the instrument for NCSG was applied. The error was applied in a conservative manner for the period between the scheduled AST and the actual date of the AST. The error was applied for the period from 10/06/2010 to 01/07/2010 (end of this monitoring period)

Data / Parameter:	**VSG**
Data 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 5: **41,138** Value applicable for Project Campaign 6: **40,976** Value applicable for Project Campaign 7: **40,196**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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) combined uncertainty after normalisation by PSG and TSG is 3.22%* Serial Number: 0305RT32A11B3 Calibration frequency: - *External calibration: QAL2 every 5 years*; - *External calibration: AST every year*; - *Internal calibrations: after each campaign (usually every 4 month)* Date of internal calibration: 28/05/2009 Date of internal calibration: 17/11/2009 Date of internal calibration: 23/03/2010 Date of internal calibration: 19/07/2010

	Date of last external calibration: *QAL2 Test – 07/02/2008 - 13/02/2008 valid until 06/02/2013* *AST – 10/06/2009 - 11/06/2009 valid until 09/06/2010* *AST – 06/07/2010 valid until 05/07/2011*
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 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 PE_n.
QA/QC procedures applied:	Internal calibration at least once per year usually every 4 month (after each campaign as the plant has to be shut down to conduct calibration) by the Instrument Department of AEL. Date of internal calibration :28/05/2009 Date of internal calibration :17/11/2009 Date of internal calibration :23/03/2010 Date of internal calibration :19/07/2010 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) Calibration delay: In order to adhere the guidelines for assessing compliance with the calibration frequency requirements as stipulated in EB 52 annex 60 the maximum permissible error of the instruments for VSG was applied. The combined error for Stack gas flow, TSG and PSG was applied to the results for VSG. The error was applied in a

	conservative manner for the period between the scheduled AST and the actual date of the AST. The error was applied for the period from 10/06/2010 to 01/07/2010 (end of this monitoring period)

Data / Parameter:	**PE_n**
Data 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 5: **33.513** Value applicable for Project Campaign 6: **23.905** Value applicable for Project Campaign 7: **19.261**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	$PE_n = VSG * NCSG * 10^{-9} * OH$ QAL2 factors have been applied to NCSG and VSG values. These correction factors were determined during the QAL2 test according to EN 14181.
QA/QC procedures applied:	Not applicable.

Data / Parameter:	**OH_n**
Data 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:	Value applicable for Project Campaign 5: **1,893** Value applicable for Project Campaign 6: **1,326** Value applicable for Project Campaign 7: **842**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable.
Measuring/ Reading/ Recording frequency:	The total operating hours are logged continuously.

Calculation method (if applicable):	Since the design plant operating temperature is between 800 °C and 915 °C, by definition the plant is offline if the temperature recorded is at or below 800 °C. For practical purposes, each hour for which the ammonia oxidation temperature (OT_h) was recorded to be below 810 °C is excluded from the determination of OH.
QA/QC procedures applied:	The production logging process is subject to ISO 9001 procedures

Data / Parameter:	**NAP**
Data 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:	Value applicable for Project Campaign 5 : **22,642.29** Value applicable for Project Campaign 6 : **16,293.70** Value applicable for Project Campaign 7 : **9,901.80**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Emerson Coriolis mass flow meter CMF 200 Overall measurement accuracy: *<=0.1%* Serial Number: 12032709 Calibration frequency: every 3 years Date of last calibration, 24/02/2009 valid until 23/02/2012
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 applied:	The mass flow meter is calibrated in regular intervals.

Data / Parameter:	**TSG**
Data 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.
Indicate what the data are used for (Baseline/ Project/ Leakage emission	Project emission calculations.

calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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: Every 4 month (only during plant shut down) validity 1 year* Date of internal calibration :28/05/2009 Date of internal calibration :17/11/2009 Date of internal calibration :23/03/2010 Date of internal calibration :19/07/2010 Date of last external calibration: *QAL2 Test – 07/02/2008 - 13/02/2008 valid until 06/02/2013AST–10/06/2009-11/06/2009 valid until 09/06/2010* *AST– 06/07/2010 valid until 05/07/2011*
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 applied:	Internal calibration at least once per year usually every 4 month 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. Date of internal calibration :28/05/2009 Date of internal calibration :17/11/2009 Date of internal calibration :23/03/2010 Date of internal calibration :19/07/2010 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) Calibration delay: In order to adhere the guidelines for assessing compliance with the calibration frequency requirements as stipulated in EB 52 annex 60 the maximum permissible error of the instruments for VSG was applied. The combined error for Stack gas flow, TSG and PSG was applied to the results for VSG. The error was applied in a conservative manner for the period between the scheduled AST test and the actual date of the AST test. The error was applied for the period from 10/06/2010 to 01/07/2010 (end of this monitoring period)

Data / Parameter:	**PSG**
Data 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.
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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: Every 4 month (only during plant shut down)* validity 1 year Date of internal calibration :28/05/2009 Date of internal calibration :17/11/2009 Date of internal calibration :23/03/2010 Date of internal calibration :19/07/2010 Date of last external calibration: *QAL2 Test – 07/02/2008 - 13/02/2008 valid until 06/02/2013* *AST – 10/06/2009-11/06/2009 valid until 09/06/2010* *AST – 06/07/2010 valid until 05/07/2011*
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 applied:	Internal calibration at least once per year usually every 4 month 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. Date of internal calibration :28/05/2009 Date of internal calibration :17/11/2009 Date of internal calibration :23/03/2010 Date of internal calibration :19/07/2010 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)

	Calibration delay: In order to adhere the guidelines for assessing compliance with the calibration frequency requirements as stipulated in EB 52 annex 60 the maximum permissible error of the instruments for VSG was applied. The combined error for Stack gas flow, TSG and PSG was applied to the results for VSG. The error was applied in a conservative manner for the period between the scheduled AST and the actual date of the AST. The error was applied for the period from 10/06/2010 to 01/07/2010 (end of this monitoring period)

Data / Parameter:	**EF_n**
Data 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:	Value applicable for Project Campaign 5: **0.00148** Value applicable for Project Campaign 6: **0.00147** Value applicable for Project Campaign 7: **0.00195**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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 applied:	Not applicable.

Data / Parameter:	**$EF_{ma,n}$**
Data 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:	Value applicable for Project Campaign 5: **0.00173** Value applicable for Project Campaign 6: **0.00169** Value applicable for Project Campaign 7: **0.00172**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations.

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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 applied:	Not applicable.

Data / Parameter:	**EF_p**
Data 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:	Value applicable for Project Campaign 5: **0.00173** Value applicable for Project Campaign 6: **0.00169** Value applicable for Project Campaign 7: **0.00195**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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 applied:	Not applicable.

Data / Parameter:	**EF_{min}**
Data 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 $EF_{ma,n}$.

Value(s) of monitored parameter:	**Not applicable, will be calculated after 10 project campaigns**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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 an EF_n that is lower than EF_{min}, the calculation of the emission reductions for that particular campaign shall used EF_{min} and not EF_n.
QA/QC procedures applied:	Not applicable.

Data / Parameter:	**CL_n**
Data 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:	Value applicable for Project Campaign 5: **22,642.29** Value applicable for Project Campaign 6: **16,293.70** Value applicable for Project Campaign 7: **9,901.80**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Project emission calculations.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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 applied:	See comments for NAP above

Data / Parameter:	**OP_h**
Data unit:	**kPa (gauge)**
Description:	Oxidation Pressure for each hour
Measured /Calculated /Default:	Measured.
Source of data:	Monitoring results of a pressure transmitter on the ammonia oxidation reactor (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.**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Not applicable.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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: 06/03/2009, 05/11/2009, 04/05/2010, 28/08/2010
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 applied:	The instrument is subject to yearly internal calibrations. The QA/QC procedures are part of the ISO 9001 procedures.

Data / Parameter:	**OT_h**
Data 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.**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Not applicable.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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: 09/03/2009, 04/11/2009, 04/05/2010, 28/08/2010
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 applied:	The instrument is subject to yearly internal calibrations, which are part of the ISO 9001 procedures.

Data / Parameter:	**AFR**
Data unit:	**tNH_3/h**
Description:	Ammonia gas flow rate to the ammonia oxidation reactor.
Measured /Calculated /Default:	Measured.
Source of data:	Differential pressure measurement (orifice plate) 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**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Not applicable.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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: 06/03/2009, 05/11/2009, 04/05/2010, 28/08/2010
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 applied:	The instrument is subject to yearly internal calibrations, which are part of the ISO 9001 procedures.

Data / Parameter:	**AIFR**
Data 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**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Not applicable.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	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: 06/03/2009, 05/11/2009, 04/05/2010, 28/08/2010
Measuring/ Reading/	The measurement results are taken by the data acquisition and

Recording frequency:	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 applied:	Not applicable.

Data / Parameter:	**$GS_{project}$**
Data 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**
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Not applicable.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	Not applicable.
QA/QC procedures applied:	Not applicable.

Data / Parameter:	**$GC_{project}$**
Data 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 5: Platinum (Pt) 59; Rhodium (Rh) 4, Palladium (Pd) 37 Project campaign 6: Platinum (Pt) 59; Rhodium (Rh) 4, Palladium (Pd) 37 Project campaign 7: Platinum (Pt) 59; Rhodium (Rh) 4, Palladium (Pd) 37
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Not applicable.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	Not applicable.
QA/QC procedures applied:	Not applicable.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

>>

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 Annex 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 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 or 860 kPa – 910 kPa
Maximum ammonia flow rate: 3.877 t/h
Maximum ammonia to air ratio: 0.115 or 11.5%

CL_{normal}: 24,026.2 t HNO_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	1764.44
QAL2 NCSG		0.97
VSG_{BL}	Nm³/h	42983
QAL2 VSG		0.962
OH_{BL}	h	1,474
NAP_{BL}	t HNO_3	17718.00
BE	t N_2O	104.315
UNC		4.20
EF_{BL}	**kg N_2O/t HNO_3**	**5.64**

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}.

Since $CL_{BL} < CL_{normal}$, CL_n has to be compared to CL_{BL} instead of CL_{normal}. If $CL_n < CL_{normal}$ but $CL_n > CL_{BL}$, the Baseline Emission factor can be used without adjustment. EF_{BL} only has to be adjusted when $CL_n < CL_{normal}$ and $CL_n < CL_{BL}$.

For the project campaign 5 CL_n is longer than CL_{BL}, therefore no adjustment of the Baseline emissions factor EF_{BL} is necessary.

New calculation of Baseline emissions factor due to $CL_n < CL_{BL}$

Since for the project campaigns 6 (PC6) and 7 (PC7) $CL_n < CL_{BL}$, 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}
The results of the baseline recalculation for project campaigns 6 and 7 (PC6 and PC7) are as follows:

		Racalculation of baseline for project campaign 6	Racalculation of baseline for project campaign 7
$NCSG_{BL}$	mg/Nm³	1,756.03	1,635.95
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	103.817	96.718
UNC		4.20	4.20
EF_{BL}	**kg N_2O/t HNO_3**	**5.61**	**5.23**

As a result of this recalculation the new EF_{BL} to be applied for project campaign 6 (PC6) is 5.61 kgN_2O/tHNO_3.
As a result of this recalculation the new EF_{BL} to be applied for project campaign 7(PC7) is 5.23 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. Project emissions calculation

>>

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.

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 Calculatio	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	H 24	05.08.09	- 01.11.09
Project campaign 5	**Query 1: Without parameter limits**								88
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	2,122	2,122	2,122	2,122	2,122	2,122		2,122	
Minimum		0.00	0.00	36	800	0.00		2,073	
Maximum		3.37	0.8	917,666	902	1,904.96		42,150	
Mean		2.84	0.11	795,991	889	429.85		36,784	
Standard deviation		1.009	0.05	279,878	31	224.38		11,850	
95% confidence level *(1.96 * Std.dev.)*		*1.98*	*0.10*	*548,562*	*62*	*439.78*		*23,226*	
Sum	2,122								22,642.29
Limits acc. to consistency check									
Lower limit									
Upper limit									

According to this Query 1, the NAP value of Project campaign 5 is 22,642 t of nitric acid

N.DBMS Project Campaign Calculatio	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	H 25	30.11.09	- 07.03.10
Project campaign 6	**Query 1: Without parameter limits**								108
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	2,330	2,330	2,330	2,330	2,330	2,330		2,330	
Minimum		0.00	0.00	71	800	0.00		1,409	
Maximum		3.32	1.0	911,111	904	2,194.06		41,827	
Mean		1.78	0.16	511,778	857	286.30		24,466	
Standard deviation		1.552	0.09	443,462	49	279.28		18,880	
95% confidence level *(1.96 * Std.dev.)*		*3.04*	*0.18*	*869,186*	*97*	*547.38*		*37,005*	
Sum	2,330								16,293.70
Limits acc. to consistency check									
Lower limit									
Upper limit									
According to this Query 1, the NAP value of Project campaign 6 is 16,294 t of nitric acid									

N.DBMS Project Campaign Calculatio	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	H 26	08.04.10	- 01.07.10
Project campaign 7	**Query 1: Without parameter limits**								128
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	2,022	2,022	2,022	2,022	2,022	2,022		2,022	
Minimum		0.00	0.00	901,505	800	0.00		0	
Maximum		3.30	1.0	901,505	903	4,032.45		43,335	
Mean		1.26	0.15	901,505	840	273.60		18,313	
Standard deviation		1.472	0.14	0	48	398.15		18,334	
95% confidence level *(1.96 * Std.dev.)*		*2.89*	*0.27*	*0*	*94*	*780.38*		*35,934*	
Sum	2,022								9,901.80
Limits acc. to consistency check									
Lower limit									
Upper limit									
According to this Query 1, the NAP value of Project campaign 7 is 9,902 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 Calculatio	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	H 24	05.08.09	- 01.11.09
Project campaign 5	**Query 2: With operational limits**								92
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	1,893	1,893	1,893	1,893	1,893	1,893		1,893	
Minimum		0.89	0.08	262,605	818	209.84		14,336	
Maximum		3.37	0.10	917,666	902	1,904.96		42,150	
Mean		3.18	0.10	890,938	899	481.03		40,794	
Standard deviation		0.237	0.002	63,634	7.6	178.45		2,532	
95% confidence level *(1.96 * Std.dev.)*		0.465	0.004	124,723	14.8	349.76		4,963	
Sum	1,893								22,642.29
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 5 is 1,893 h.									

N.DBMS Project Campaign Calculatio	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	H 25	30.11.09	- 07.03.10
Project campaign 6	**Query 2: With operational limits**								112
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	1,326	1,326	1,326	1,326	1,326	1,326		1,326	
Minimum		0.00	0.04	111,545	812	98.18		14,226	
Maximum		3.32	0.12	911,111	904	2,194.06		41,827	
Mean		3.13	0.10	895,859	900	498.49		40,795	
Standard deviation		0.177	0.003	51,596	6.5	174.44		1,754	
95% confidence level *(1.96 * Std.dev.)*		0.348	0.005	101,129	12.7	341.90		3,438	
Sum	1,326								16,293.70
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 6 is 1,326 h.									

N.DBMS Project Campaign Calculatio	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	H 26	08.04.10	- 01.07.10
Project campaign 7	**Query 2: With operational limits**								132
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	842	842	842	842	842	842		842	
Minimum		0.43	0.03	901,505	811	132.25		11,514	
Maximum		3.30	0.10	901,505	903	4,032.45		43,335	
Mean		2.99	0.10	901,505	896	652.26		39,694	
Standard deviation		0.318	0.007	0	11.8	365.88		3,115	
95% confidence level *(1.96 * Std.dev.)*		0.624	0.015	0	23.1	717.12		6,106	
Sum	842								9,901.80
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 7 is 842 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 Calculatio	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	H 24	05.08.09	- 01.11.09
Project campaign 5	**Q6: Q2 + confidence levels**					96		100	92
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						1,804		1,848	
Minimum		0.886	0.08	262,605	818	209.84		35,935	
Maximum		3.37	0.10	917,666	902	830.69		42,150	
Mean		3.18	0.10	890,938	899	461.18		41,138	
Standard deviation		0.237	0.002	63,634	7.6	155.96		528	
95% confidence level *(1.96 * Std.dev.)*		0.465	0.004	124,723	14.8	305.69		1,034	
Sum	1,893								22,642.29
Limits acc. to consistency check									
Lower limit					810	131.26		35,831	
Upper limit						830.79		45,757	
			Correction factors resulting from QAL2			0.9700		0.9620	
Campaign emissions	**PE**		*= VSG * NCSG * Oh * 10^{-9}*					t N2O	**33.513**
Emission factor	**EF_n**		*= PE / NAP * 10^{3}*					kg N2O / t HNO3	**1.48**
As a result of this query the mean NCSG value for Project campaign 5 is 461.18 mg N2O / Nm3									
As a result of this query the mean VSG value for Project campaign 5 is 41,138 Nm3 / h									
As a result of this query the result for EFn for Project campaign 5 is 01.48 kg N2O / t HNO3									

N.DBMS Project Campaign Calculatioi	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	H 25	30.11.09	- 07.03.10
Project campaign 6	Q6: Q2 + confidence levels					116		120	112
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						1,244		1,310	
Minimum		0.003	0.04	111,545	812	169.55		38,312	
Maximum		3.32	0.12	911,111	904	786.27		41,827	
Mean		3.13	0.10	895,859	900	471.48		40,976	
Standard deviation		0.177	0.003	51,596	6.5	100.96		327	
95% confidence level *(1.96 * Std.dev.)*		0.348	0.005	101,129	12.7	197.87		641	
Sum	1,326								16,293.70
Limits acc. to consistency check									
Lower limit					810	157		37,357	
Upper limit						840		44,234	
			Correction factors resulting from QAL2			0.9700		0.9620	
Campaign emissions	**PE**		*= VSG * NCSG * Oh * 10^{-9}*					t N2O	**23.905**
Emission factor	**EF_n**		*= PE / NAP * 10^{3}*					kg N2O / t HNO3	**1.47**

As a result of this query the mean NCSG value for Project campaign 6 is 471.48 mg N2O / Nm3
As a result of this query the mean VSG value for Project campaign 6 is 40,976 Nm3 / h
As a result of this query the result for EFn for Project campaign 6 is 01.47 kg N2O / t HNO3

N.DBMS Project Campaign Calculatioi	Project:	AEL No. 9, Johannesburg, South Africa				Campaign:	H 26	08.04.10	- 01.07.10
Project campaign 7	Q6: Q2 + confidence levels					136		140	132
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						829		817	
Remaining share of data sets									
Minimum		0.430	0.03	901,505	811	132.25		35,323	
Maximum		3.30	0.10	901,505	903	864.90		43,335	
Mean		2.99	0.10	901,505	896	609.86		40,196	
Standard deviation		0.318	0.007	0	11.8	86.49		530	
95% confidence level *(1.96 * Std.dev.)*		0.624	0.015	0	23.1	169.51		1,038	
Sum	842								9,901.80
Limits acc. to consistency check									
Lower limit					810	0.00		33,587	
Upper limit						1,369.37		45,800	
			Correction factors resulting from QAL2			0.9700		0.9620	
Campaign emissions	**PE**		*= VSG * NCSG * Oh * 10^{-9}*					t N2O	**19.261**
Emission factor	**EF_n**		*= PE / NAP * 10^{3}*					kg N2O / t HNO3	**1.95**

As a result of this query the mean NCSG value for Project campaign 7 is 609.86 mg N2O / Nm3
As a result of this query the mean VSG value for Project campaign 7 is 40,196 Nm3 / h
As a result of this query the result for EFn for Project campaign 7 is 01.95 kg N2O / t HNO3

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 campaigns covered by this monitoring report are:

Campaign	PE	EF_n
Project Campaign 5 (PC5)	33.513 tN2O	1.48 $kgN_2O/tHNO_3$
Project Campaign 6 (PC6)	23.905 tN2O	1.47 $kgN_2O/tHNO_3$
Project Campaign 7 (PC7)	19.261 tN2O	1.95 $kgN_2O/tHNO_3$

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 campaigns 5 the CL_n is longer than CL_{BL}, therefore no adjustment of the Baseline emissions factor EF_{BL} is necessary.

Since for the project campaigns 6 (PC6) and 7 (PC7) $CL_n < CL_{BL}$, 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} See section : *New calculation of Baseline emissions factor due to $CL_n < CL_{BL}$* above.

E.3. Leakage calculation

>>

No leakage occurs under this project type.

E.4. Emission reductions calculation / table

>>

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 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. As this project campaign of this current monitoring period is only the 8th project campaign consideration of EF_{min} is not yet of relevance.

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:

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

Where:

Variable	Definition
ER	Emission reductions of the project for the specific campaign (tCO_2e)
NAP	Nitric acid production for the project campaign ($tHNO_3$). The maximum value of NAP shall not exceed the design capacity.
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_N_2O	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 5 (PC5): 05/08/2009 - 01/11/2009	Project campaign 6 (PC6): 30/11/2009 - 07/03/2010	Project campaign 7 (PC7): 08/04/2010 - 01/07/2010
$NCSG_{BL}$	mg/Nm³	1,764.44	1,756.03	1,635.95
QAL2 NCSG		0.97	0.97	0.97
VSG_{BL}	Nm³/h	42,983	42,983	42,983
QAL2 VSG		0.962	0.962	0.962
OH_{BL}	h	1,474	1,474	1,474
NAP_{BL}	t HNO_3	17,718	17,718	17,718
BE	t N_2O	104.315	103.817	96.718
UNC		4.20	4.20	4.20
EF_{BL}	**kg N_2O/t HNO_3**	**5.64**	**5.61**	**5.23**
$NCSG_n$	mg/Nm³	461.18	471.48	609.86
QAL2 NCSG		0.97	0.97	0.97
VSG_n	Nm³/h	41,138	40,976	40,196
QAL2 VSG		0.962	0.962	0.962
OH_n	h	1,893	1,326	842
NAP_n	t HNO_3	22,642	16,294	9,902
PE_n	t N_2O	33.513	23.905	19.261
EF_n	kg N_2O/t HNO_3	1.48	1.47	1.95
$EF_{ma,n}$	kg N_2O/t HNO_3	1.73	1.69	1.72
EF_{min}	kg N_2O/t HNO_3	n/a	n/a	n/a
EF_p	**kg N_2O/t HNO_3**	**1.73**	**1.69**	**1.95**
GWP	tCO_2e/tN_2O	310.00	310.00	310.00
ER	**tCO_2e**	**27,435**	**19,829**	**10,081**
Total ER for the monitoring period			**57,345**	

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 96,689 tonnes for a period of 331 days. Therefore the factual production of 48,831 tonnes during this monitoring period is below the design capacity of the plant.

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

>>
This section shall include a comparison of actual values of the emission reductions achieved during the monitoring period with the estimations in the registered CDM-PDD.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	**116,779 tonnes CO_2e per year i. e 105,901 for a period of 331 days**	**57,345 tonnes CO_2e during the monitoring period (331 days)**

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

>>

The achieved amount of emission reductions during this monitoring period is 57,345 tonnes of CO_2e and therefore lower than the estimated amount according to the PDD. The reason for this is a considerably lower nitric acid production compared to the estimations in the PDD. Also the abatement performance was lower than expected and the baseline emission factor was lower than the estimated value that was given in the registered PDD.

\- - - - -

History of the document

Version	Date	Nature of revision
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Guideline, Form **Business Function**: Issuance		