VERIFICATION / CERTIFICATION REPORT

"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"

(UNFCCC Registration Ref. No. 1171)

Monitoring Period:
12 March 2012 to 13 March 2013

REPORT NO. 2014-0506
REVISION NO. 01

DET NORSKE VERITAS[TM]

Verification/certification of project activity "Project for the catalytic reduction of N2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa" in South Africa	
For: African Explosives Ltd.	
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Summary:

DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions reported for the project activity "Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa" in South Africa" (UNFCCC Registration Ref. No. 1171) for the period 12 March 2012 to 13 March 2013.

In our opinion, the GHG emission reductions reported for the project in the monitoring report (version 03) of 1 July 2014 are fairly stated.

The GHG emission reductions were calculated correctly on the basis of the approved monitoring methodology AM0034 (version 02) and the monitoring plan contained in the revised Project Design Document of 1 July 2014.

DNV Climate Change Services AS is able to certify that the emission reductions from the project activity "Project for the catalytic reduction of N2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa" in South Africa during the period 18 April 2012 to 31 December 2012 amount to 48 571 tonnes of CO_2 equivalent and the emission reductions during the period 1 January 2013 to13 March 2013 amount to 15 251 tonnes of CO_2 equivalent.

Prepared by:	Verified by:	Approved by:
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	Keywords
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Rev. No.	Date	Reason for Issue
01	4 July 2014	First version of final verification/certification report

Reference to part of this report which may lead to misinterpretation is not permissible.

Table of Content ***Page***

Abbreviations

AEL	African Explosives Ltd.
AMS	Automated Measuring System
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CER	Certified Emission Reduction(s)
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DNV	Det Norske Veritas
DNA	Designated National Authority
DOE	Designated Operational Entity
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
MP	Monitoring Plan
NCSG	N_2O concentration in the stack gas
NG	Natural Gas
N_2O	Nitrous oxide
PDD	Project Design Document
QAL1	One of the Quality Assurance Levels defined by EN 14181:2004 “Stationary source emissions – quality assurance of automated measuring systems”.
QAL2	One of the Quality Assurance Levels defined by EN 14181:2004 “Stationary source emissions – quality assurance of automated measuring systems”.
QAL3	One of the Quality Assurance Levels defined by EN 14181:2004 “Stationary source emissions – quality assurance of automated measuring systems”.
QMS	Quality Management System
SRM	Standard Reference Method
UNFCCC	United Nations Framework Convention for Climate Change
VSG	Volume of stack gas

1 INTRODUCTION

African Explosives Ltd. (hereafter AEL) has commissioned DNV Climate Change Services AS (DNV) to carry out the verification and certification of emission reductions reported for the CDM project activity 1171 "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" in South Africa (the project) for the period 12 March 2012 to 13 March 2013. This report contains the findings from the verification and a certification statement for the certified emission reductions.

1.1 Objective

Verification is the periodic independent review and *ex post* determination by a Designated Operational Entity (DOE) of the monitored reductions in GHG emissions that have occurred as a result of the registered CDM project activity during a defined monitoring period.

Certification is the written assurance by a DOE that, during a specific period in time, a project activity achieved the emission reductions as verified.

The objective of this verification was to verify and certify emission reductions reported for the "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" for the period 12 March 2012 to 13 March 2013.

1.2 Scope

The scope of the verification is to verify that:

- The project activity has been implemented and operated in accordance with the registered PDD or any approved revised PDD;
- The monitoring plan complies with the monitoring methodology and the actual monitoring complies with the monitoring plan, including compliance with any guidance provided by the Board regarding deviations from the provisions of a registered plan and/or methodology;
- The data and calculation of GHG emission reductions have been assessed to correctly support the emission reductions being claimed.

The verification shall ensure that reported emission reductions are complete and accurate in order to be certified.

1.3 Description of the project activity

Project Parties:	South Africa (host), United Kingdom of Great Britain and Northern Ireland and Switzerland
Title of project activity:	Project for the catalytic reduction of N2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa

UNFCCC registration No:	1171
Baseline and monitoring methodology	AM0034 (version 02)
Sectoral scope(s):	
Project Participants:	African Explosives Ltd (“AEL”), N.serve Environmental services GmbH, Germany (“N.serve”)
Location of the project activity:	Modderfontein 1645, Province of Gauteng, South Africa.
Project’s crediting period:	05 Nov 07 to 04 Nov 17 (Fixed)
Period verified in this verification:	12 March 2012 to 13 March 2013

The emission reductions reported from the project for the period from 12 March 2012 to 13 March 2013 amount to 63 822 tonnes of CO_2 equivalent.

1.4 Methodology for determining emission reductions

The project activity involves the installation of a secondary N_2O catalyst inside the ammonia oxidation reactor (burner) just beneath the precious metal catalyst gauze catalyst. The N_2O catalyst is selective and promotes the decomposition of N_2O to nitrogen and oxygen. Secondary abatement technologies will normally reduce the emissions by 70-90%. Monitoring of emission reductions is done 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 Norm EN 14181 as required by the methodology.

The emission reductions for the project activity over a specific campaign are determined by deducting the campaign-specific emission factor from the baseline emission factor and multiplying the result by the production output of 100% concentrated nitric acid over the campaign period and the GWP of N_2O. The nitric acid production for the project campaign ($tHNO_3$), NAP, shall not exceed the design capacity.

The baseline emission factor is determined ex-ante, and may necessarily be re-calculated when the length of a project campaign is shorter than the normal campaign length as defined by the historic campaigns. The flow-rate of stack gas, the concentration of N_2O in the stack gas, the operating hours, and the production output of 100% concentrated nitric acid need to be monitored in order to calculate the campaign-specific emission factor and the emission reductions for a specific campaign. The emission reductions for a monitoring period are the sum of emission reductions for each campaign within the monitoring period.

In accordance to the applied methodology AM0034 version 02, the emission reductions for the project activity over a specific campaign are determined by deducting the campaign-specific emission factor from the baseline emission factor and multiplying the result by the production output of 100% concentrated nitric acid over the campaign period and the GWP of N_2O as follows:

$$ER = (EF_{BL} - EF_P) * NAP * GWP_{N2O} \quad (tCO_{2e})$$

Where:

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

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

GWP_{N2O} Global warming potential of N_2O = 310 for prior to 31 December 2012 and 298 from 1 January 2013 onwards

The average mass of N_2O baseline emissions per hour is estimated as the product of the nitrous oxide concentration in the stack gas (NCSG) and the volume flow rate in the stack gas (VSG). The N_2O emissions during the baseline campaign are estimated from the product of N_2O emission per hour and the total number of complete hours of operation of the baseline campaign using the following equation:

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

The plant specific baseline emissions factor representing the average N_2O emissions per tonne of nitric acid over one full campaign is derived by dividing the total mass of N_2O emissions by the total output of 100% concentrated nitric acid for that period. The overall uncertainty of the monitoring system is determined and the measurement error is expressed as a percentage (*UNC*). The N_2O emission factor per tonne of nitric acid produced in the baseline period (EF_{BL}) shall then be reduced by the estimated percentage error as follows:

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

Where:

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

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

$$PE_n = VSG * NCSG * 10^{-9} * OH \quad (tN_2O)$$

Where:

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 nth project campaign (tN_2O)
OH	The total number of operation hours of the project campaign (h)

A campaign specific emissions factor 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 as follows:

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

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

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

To calculate the total emission reductions achieved in a campaign, the higher of the two values between $EF_{ma,n}$ and EF_n is applied as the emission factor relevant for the particular campaign (EF_p). This emission factor (EF_p) is then used to calculate emissions reductions using the equation given above for ER. Thus:

If $EF_{ma,n} > EF_n$ then $EF_p = EF_{ma,n}$
If $EF_{ma,n} < EF_n$ then $EF_p = EF_n$

Further a campaign-specific emissions factor is 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 was adopted as a minimum (EF_{min}). And where 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 uses EF_{min} and not EF_n for emission reductions calculation. Further, EF_{reg} is also monitored to check if the host party has introduced regulations set by government to cap N_2O emission from nitric acid (HNO_3) plants.
As per the applied methodology, AM0034 version 2 no leakage calculation is required.

2 METHODOLOGY

DNV has assessed and determined that the implementation and operation of the project activity, and the steps taken to report emission reductions comply with the CDM criteria and relevant guidance provided by the Board.

The assessment involved a desk review of relevant documentation as well as an on-site visit. The verification of the emission reductions has assessed all factors and issues that constitute the basis for emission reductions from the project. All relevant records of data from the N.serve Database Management System for N_2O destruction system (N.DBMS) /3/ and records from the production logs of the nitric acid production have been examined and verified for the reporting period.

Verification team

				Type of involvement					
Role	***Last Name***	***First Name***	***Country***	Desk review	Site visit	Reporting	Supervision of work	Technical review	TA 5.1 competence
Team leader (Verifier)	Khawaja	Rafi	Norway	✓	✓	✓	✓		
Verifier/Expert	Kopperud	Trine	Norway	✓	✓	✓			✓
Technical reviewer	Prabhu	Ravi Kumar	India					✓	✓

Duration of verification

Monitoring report publication: 25 November 2013
Desk review: 25 November 2013 to 10 December 2013
On-site assessment: 11 December 2013 to 12 December 2013
Reporting, calculation checks and QA/QC: 13 December to 4 July 2014

2.1 Desk review

In addition to the monitoring report (version 01 dated 22 November 2013 and version 03 dated 1 July 2014) /1/, DNV reviewed:

- The PDD for the project activity of 5 April 2007 and the updated PDD version 3.0 of 1 July 2014 /28/
- The previous verification report /29/
- Baseline and monitoring methodology AM0034, version 02 /34/

The project operator, in addition, supplied the verification team with procedures from its management system as well as other documentation and spreadsheets with all data necessary for verification of the emission reductions /2/ and /3/ - /27/.

2.2 On-site assessment

From 11 December 2013 to 12 December 2013 DNV performed on-site assessments. During the on-site assessment DNV carried out:

- An assessment of the implementation and operation of the registered project activity is as per the PDD for the project activity of (PDD of 5 April 2007 and revised PDD of 1 July 2014) /28/;
- A review of information flows for generating, aggregating and reporting the monitoring parameters;
- Interviews with relevant personnel to determine whether the operational and data collection procedures are implemented in accordance with the monitoring plan in the PDD;
- A cross check between information provided in the monitoring report and logbooks, inventories, purchase records or similar data sources;
- A check of the monitoring equipment including calibration performance and observations of monitoring practices against the requirements of monitoring plan.
- A review of calculations and assumptions made in determining the GHG data and emission reductions; and
- An assessment that quality control and quality assurance procedures are in place to identify and prevent or correct any errors or omissions in the reported monitoring parameters.

The data presented in the monitoring report /1/ was assessed by review of the detailed project documentation and production records, as well as by interviews with personnel at African Explosives Ltd. and N.serve /35/-/37/, by observation of established monitoring and reporting practices and collection of measurements, and by assessment of the reliability of the installed monitoring equipment. This has enabled the verification team to assess the accuracy and completeness of the reported monitoring results, and to verify the correct application of the approved monitoring methodology and the determination of the reductions in N_2O emissions.

In addition all parameters required by the monitoring methodology AM0034 version 02 /34/ and the management system were assessed during the site visit

2.3 Closing out of verification findings

The objective of this phase of the verification was to resolve any issues which needed be clarified prior to DNV's conclusion that i) the project activity has been implemented and operated in accordance with the registered PDD or any approved revised PDD, ii) the monitoring plan complies with the monitoring methodology and the actual monitoring complies with the monitoring plan and iii) the data and calculation of GHG emission reductions are correct.

A corrective action request (CAR) is issued, where:

i. Non-conformities with the monitoring plan or methodology are found in monitoring and reporting and has not been sufficiently documented by the project participants, or if the evidence provided to prove conformity is insufficient;
ii. Modifications to the implementation, operation and monitoring of the registered project activity has not been sufficiently documented by the project participants;

iii. Mistakes have been made in applying assumptions, data or calculations of emission reductions which will impair the estimate of emission reductions;

iv. Issues identified in a FAR during validation to be verified during verification have not been resolved by the project participants.

A clarification request (CL) shall be raised if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

A forward action request (FAR) is issued for actions if the monitoring and reporting require attention and/or adjustment for the next monitoring period.

The verification identified four CARs, two CLs and one FAR. The CARs and CLs were satisfactorily addressed by the project participants by among other revising the monitoring (please refer to Appendix A for further details). In addition to the changes made to the monitoring report as a result of the verification findings, no changes to the monitoring report (version 03 dated 1 July 2014) were made compared to the initial version of the monitoring report received for verification (version 01 dated 22 November 2013):

3 VERIFICATION FINDINGS

This section summarises the findings from the verification of the emission reductions reported for the "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" for the period 12 March 2012 to 13 March 2013.

3.1 Remaining issues, CARs, FARs from previous validation / verification

There are no remaining issue (FARs) from the previous verification /29/.

3.2 Post registration changes

A Flexim Ultrasonic flow meter has been installed since 02 August 2011 in parallel to the Coriolis mass flow meter, initially for testing purposes. However, from the start of the first project campaign of this monitoring period (PC13) on 20 June 2012 and thus for the entire monitoring period, the values from the new ultrasonic flow meter were recorded and utilized for NAP. The NAP monitoring practice as described in the PDD has been permanently changed since the start of this monitoring period, and thus changes to the PDD are needed which are submitted as post registration changes along with this issuance request.

DNV has confirmed that the calibration of the Flexim Ultrasonic flow meter was done 11 March 2011 /26/.

The assessment of compliance with the project description and the monitoring plan contained in the PDD, as described in the following sections, is based on the revised PDD (version 3.0 of 1 July 2014).

3.3 Project implementation

As part of the site visit, DNV verified that the project is fully implemented in accordance with the PDD version 2.0 of 5 April 2007 and the revised PDD version 3.0 of 1 July 2014 /28/. The verification team confirmed through visual inspection, that all physical features (technology, project equipment and monitoring/metering equipment) including data collection systems and storage of the CDM project activity are in place as per the registered PDD and the project is completely operational.

The baseline campaign was operated from 5 September 2007 to 6 November 2007. As confirmed in the validation report /30/, the data from the baseline campaign were not verified by the validating DOE, and the confirmation of the baseline campaign data to be used for ex-post emission reduction calculations was included in the scope of the verifying DOE. Thus the baseline campaign was verified by DNV during the first verification period simultaneously with first project's campaigns /29/. The project was registered on 5 November 2007, which is also the start date of the crediting period. The first project campaign with secondary catalyst installed was started on 9 November 2007. This monitoring period is from 12 March 2012 to 13 March 2013 and comprises of three project campaigns as stated below.

- Campaign PC13 20 June 2012 to 11 October 2012
- Campaign PC14 13 October 2012 to 10 February 2013
- Compaign PC15 12 February 2013 to 11 March 2013

All the shutdown periods and special events occurring during the current monitoring period have been reported in section B.1 of the monitoring report /1/. DNV verified these shutdown periods and special events by checking the raw data, ER calculations /2/ and the daily production records for these periods /12/. It was verified by DNV that the shutdown periods (relevant hours) are not considered in the overall emission reduction calculations. Furthermore, DNV verified these events by checking the trend curves for the operation. It was confirmed that no further events had occurred during the monitoring period, which require recalculations or exclusion of additional hours in the calculation of emissions reductions. DNV can confirm there was no AMS downtime or malfunction during the verification period which would require correction to the measured data as per AM0034 requirements. However, due to AST delay corrections have been made as per para 238 of VVS /31/.

3.4 Information (data and variables) provided in the monitoring report that is different from that stated in the PDD

The emission reductions in this monitoring period are 63 822 tonnes of CO_2 equivalents in the period from 12 March 2012 to 13 March 2013 (i.e. 367 days). The yearly expected emission reductions according to the registered PDD are 116 779 tonnes of CO_2 equivalents. This corresponds to emission reductions of 117 419 tonnes of CO_2 equivalents in 367 days and hence the actually achieved emission reductions are lower than expected. The main reason for the lower than expected CERs is the lower nitric acid production than anticipated in the PDD:

Actual nitric acid production during the current monitoring period: 47 916 $tHNO_3$. Average annual nitric acid production used for CER estimates in the PDD: 69 629 $tHNO_3$/year. This corresponds to 70 011 $tHNO_3$ for a period of 367 days.

Other factors that affected the emission reduction include the lower baseline emission factor for all three project campaigns (0.00564 $tN_2O/tHNO_3$ for PC13, 0.00562 $tN_2O/tHNO_3$ for PC14, and 0.00461 $tN_2O/tHNO_3$ for PC15 which are lower than the estimated value that was given in the registered PDD, 0.00601 $tN_2O/tHNO_3$). This resulted in lower than expected baseline emissions.

Keeping the above comparison in view, DNV considers that the amount of emission reduction achieved in this monitoring period is reasonable.

3.5 Compliance of monitoring plan with monitoring methodology

DNV is able to confirm that the monitoring plan contained in the PDD (1 July 2014) is in accordance with the approved methodology applied by the project activity, i.e. AM0034 (version 02) /34/. As described above, since the NAP monitoring practice as described in the initial PDD has been permanently changed since the start of this monitoring period, and changes to the PDD were needed and these changes are submitted as post registration changes along with this issuance request (refer to section 3.2 for details).

3.6 Compliance of monitoring with the monitoring plan

The monitoring has been carried out in accordance with the monitoring plan contained in the registered PDD of 1 July 2014 as per the approved monitoring methodology, AM0034, version 02 /34/. The monitoring plan and the applied methodology have been properly implemented and followed by the project participants. The determination of the baseline

emission factor and the project emissions are verified and found to be in compliance to AM0034 version 02 /34/.

All parameters stated in the validated monitoring plan and the applied methodology AM0034 version 02 /34/ have been sufficiently monitored and updated as applicable, including: project emission parameters; baseline emission parameters; leakage emissions; management and operational system: the responsibilities and authorities for monitoring and reporting are in accordance with the responsibilities and authorities stated in the monitoring plan.

The monitoring report lists each parameter required by the monitoring plan and the information flow (i.e. from data generation, aggregation, recording, calculation and reporting) for these parameters is provided in sections C and D of the monitoring report /1/. The information flow for each parameter is further discussed in the following sections of this report. The monitoring methodologies and sustaining records are sufficient to enable verification of emission reductions.

The results from the QAL2 tests have been provided. The QAL2 test covers the most important calibration issues as per EN14181 and confirms the determination of the overall uncertainty used in the calculation of the baseline emission factor. Refer to Appendix C for detailed assessment of the monitored parameters in accordance with the Monitoring plan.

3.7 Assessment of data and calculation of emission reductions

3.7.1 Historical data and permitted operating conditions

For this project the determination of the permitted ranges, normal gauze supplier and composition were included in the scope of the validating DOE /30/. However, the verification of normal campaign length was confirmed by the verifying DOE during the first verification /29/.

The table below is summarising the permitted operating conditions and the normal campaign length.

Data variable	**Reported value**	**Observation**
Design capacity	106 621 100% metric tonnes per year based on 365 days of operation (correspond to 292.112 metric tonnes per operating day).	Verified by validating DOE /30/
OT_{normal}	810°C to 915°C	Verified by validating DOE /30/
OP_{normal}	860 to 910 kPa (gauge)	Verified by validating DOE /30/
AFR_{max}	3.877 t NH_3/h	Verified by validating DOE /30/
$AIFR_{max}$	11.5%	Verified by validating DOE /30/
CL_{normal} t HNO_3	24 026.2 tonnes	Verified during first verification /29/

CL_{BL} t HNO_3	17 718	Verified by validating DOE /30/
GS_{normal} Gauze supplier for the operation condition campaigns	W.C. Heraeus	Verified by validating DOE /30/
GC_{normal} Gauze composition for the operation condition campaigns	Platium (Pt) 59% Rhodium (Rh) 4% Palladium (Pd) 37%	Verified by validating DOE /30/

3.7.2 Information flow

The verification team assessed the information flow and data collection system and confirms that it meets the requirements of the monitoring plan contained in the registered PDD /28/ as per the applied and approved methodology, AM0034 version 02 /34/.

The verification team confirms that the monitoring report includes all parameters and the monitored data at the interval required by the methodology and the registered PDD.

The common data flow systems have been used in the project activity for the following parameters:

- Stack gas flow rate and standardization calculation
- Stack gas N_2O concentration and calculation of amount of N_2O
- Operating parameters of the ammonia oxidation reactor (temperature, pressure, ammonia input)

The instrument transmitters continuously provide an analogue signal (4 to 20 mA) from the N_2O analyzer and the stack gas flow meter including the stack gas temperature and pressure. The signals are converted by the Programmable Logic Controller (PLC) into a digital signal which is then fed into SCADA data acquisition and database system. Thus collected and processed data, i.e. calculation, raw data, calculated values, are stored in the server continuously and are available in the network system as digital values. Each of the two AEL nitric acid plants (AEL 9 and AEL 11) has its own SCADA system on a dedicated PC, however the two SCADA PCs are directly connected to each other and each of the PCs receives all the measured data from the AMS and stores them. The instrumentation engineer at the plant transfers the data at least once a week into AEL's main IT system as well as making a complete copy of that week's data (2-second, hourly and daily averages) onto an external disc drive. That way there are already four copies of the original and unchanged data stored in four different locations. In addition, the hourly data 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) /3/.

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 a 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. In addition to the Microsoft Access based excel sheet, the PP incorporated additional routines in the spreadsheet containing all the formulae of calculation as required for the determination of emission reductions by the methodology AM0034 (version 02).
At N.serve the received data is stored in the N.serve fileserver in a special section for the storage of monitoring data separately for each project. The files are protected against manipulation by a password. Martin Stilkenbäumer, at N.serve was responsible for the correct data handling and processing during the monitoing period.
The nitric acid production hourly data from the mass flow mater is transferred to the plant's process control system, and the daily cumulated production value is recorded and archived.
In order to verify that correct data is used for ER calculation, DNV checked the data from productions logs and raw data taken from the SCADA system and compared them against the data available in the excel sheets provided by N.serve.
The verification team assessed the information flow and data collection system and confirms that it meets the requirements of the monitoring plan contained in the registered PDD as per the applied and approved methodology, AM0034 Version 02. Each parameter and the values verified are listed in sections 3.7.3 to 3.7.6 below. Further detailed information on recording frequencies and calibrations are given in Appendix C.

3.7.3 Monitored data for project emissions within the project boundary

The only emission source from the project is the remaining quantity of N_2O in the stack gas.

According to AM0034 the emissions reductions for a specific project campaign can only be requested for the nitric acid production up to the design capacity. The actual production during the |monitoring period is below the design capacity of the plant and is hence fully eligible for emission reduction calculations (refer to section 3.4 for NAP comparison).

The following data and calculations were assessed by DNV as part of this verification (further details on each monitoring equipment and calibration routines are given in Appendix C):

Data variable	**Tag. No.** **Range**	**Reported value**	**Assessment /Observation**
VSG Normal gas volume flow rate of the stack gas during project campaign (Nm^3/h)	**FT-200** Range: 0-150 000 Nm³/h	Campaign 13: 42 302 Nm^3/h Campaign 14: 41 809 Nm^3/h Campaign 15: 41 643 Nm^3/h	The stack gas flow rate is continuously measured with a flow meter. Static pressure and process temperature are measured with a single pipe penetration, and compensated flow is calculated dynamically (Nm^3/h). All transmitters are properly installed. Specifications of the flow meter are provided /4/. The flow meter was calibrated prior to shipment by the supplier Emerson Rosemount and thereafter regularly in accordance with AEL calibration routine /17/.

			The measurement range of the flow meter is appropriate and the measured average flow rate is within the range expected for the nitric acid plant. Refer to Appendix C for details on monitoring instruments and calibration routines. As a result of the QAL2 /8/; the correction factor of 1.02 is to be applied on VSG measurements. Consequently, a correction factor of 1.02 has been applied to VSG data for the entire monitoring period, which was verified from the calculation spreadsheets /2/. DNV confirms that the instrument calibration is valid for the whole monitoring period. Additionally, internal calibrations are conducted and records were also verified by DNV /17/. The AST was due on 21 June 2012 (1 year after the last AST). However, AST tests were done on 04 July 2012 /8/. As per para 238 of VVS /31/ the maximum permissible error of the instruments for VSG was applied for the period from 21 June 2012 to 03 July 2012. The combined error for Stack gas flow, TSG and PSG was applied to the results for VSG. DNV confirms that the error was applied in a conservative manner for the period between the scheduled AST test and the actual date of the AST test /2/.
PSG (hPa abs)	**PT-200** Range 0 – 1000 hPa (abs).	The pressure is used for standardization of volume flow rate in the stack	The pressure in the stack gas is measured by a Rosemount pressure probe and the value is used for the normalization of stack gas flow. Refer to Appendix C for details on monitoring instrument and calibration routines. DNV confirms that the instrument calibration is valid for the whole monitoring period. Additionally, internal calibrations are conducted and records were also verified by DNV /17/.

TSG	**TE-120** Range: 0-500 °C	Temperature is used for standardization of volume flow rate in the stack	The temperature in the stack gas is measured by a thermocouple. Refer to Appendix C for details on monitoring instrument and calibration routines. DNV confirms that the instrument calibration is valid for the whole monitoring period. Additionally, internal calibrations are conducted and records were also verified by DNV /17/.
NCSG N_2O concentration in the stack gas (mgN_2O/Nm^3)	**AT-76020-2** Range: 0-2000 ppmv	Campaign 13: 205.93 mg N_2O/Nm^3 Campaign 14: 120.20 mg N_2O/Nm^3 Campaign 15: 68.26 mg N_2O/Nm^3	The concentration of N_2O in the stack gas is continuously measured by the non-dispersive infrared photometry (NDIR) analyser. The N_2O concentration is recorded every two seconds and hourly means are derived by the data acquisition system. Sufficient documentation has been provided for the fulfilment of QAL1, QAL2 and AST /5//6//7//8/. Refer to Appendix C for details on monitoring instrument and calibration routines. As a result of the latest QAL2 test, a correction factor of 0.97 is to be applied on NCSG measurements (unchanged from previous QAL2) /5/. It was verified from the calculation spreadsheets that this value has been correctly applied to NCSG data for the monitoring period /2/. DNV confirms that the instrument calibration is valid for the whole monitoring period. Additionally internal calibration was conducted and records were verified by DNV /17/. The AST was due on 21 June 2012 (1 year after the last AST). However, AST tests were done on 04 July 2012 /8/. As per para 238 of VVS /31/ the maximum permissible error of the instruments for NCSG was applied for the period from 21 June 2012 to 03 July 2012. DNV confirms that the error was applied in a conservative manner for the period between the scheduled AST test and the actual date of the AST test /2/. Since no span checks were performed for the period 05 February 2013 – 13 March 2013 /10/. As per para 238 of VVS /31/ the maximum permissible error of the instruments

			for NCSG was applied for the period from 05 February 2013 – 13 March 2013 /2/. It was verified that zero and span checks for the remaining period during the project campaign was done twice a week. Further, calibration with standard gases was performed in cases where a deviation exceeding 1% of the full range of the analyzer was detected. /10/. The span gas concentration of 1080 ppm was used to calibrate the analyser /9/. The analyser room and equipment is inspected weekly.
NAP t HNO_3 Nitric acid 100% concentrated produced over a project campaign	**FT-111**	Campaign 13: 25 757 t HNO_3 Campaign 14: 16 531 t HNO_3 Campaign 15: 5 628 t HNO_3	The Flexim Ultrasonic flow meter has been installed since 02 August 2011 in parallel to the Coriolis mass flow meter, initially for testing purposes. However, from the start of the first project campaign of this monitoring period (PC13) on 20 June 2012 and thus for the entire monitoring period, the values from the new ultrasonic flow meter were recorded and utilized for NAP. (Refer to section 3.2 above for further details). The flow meter measures the density and temperature of the acid which are used to calculate the concentration of the acid. The total mass flow is then multiplied by the calculated concentration to give 100% nitric acid. The concentration is also checked against manual measurements performed in the laboratory. Refer to Appendix C for details on monitoring instruments and calibration routines. Sampling of concentration measurements and values from mass flow meter were performed during the site visit including checks of transfer of data. NAP results are crosschecked against process parameters such as ammonia consumption and against product stock levels and product consumption. An analysis was provided to DNV showing the comparison of the NAP values determined from tank level/mass balance method and NAP values obtained from Flexim Ultrasonic flow meter. The analysis was checked by DNV and found to be appropriate.

			The flow meter is calibrated as per FLEXIM recommendations /17/.
OH_n Operating hours during project campaign	N/A	Campaign 13: 2 047 Campaign 14: 1 385 Campaign 15: 462	Operating hours are determined from the production data /2/. A trip value for the oxidation temperature of 810°C is applied as the exclusion criterion for determining those hours where the plant was offline during the project campaign (during shut down OT_h is reported at 800.6°C, while all other parameters are at zero. Thus, the trip value of 810 is used by the plant and temperatures below this value are representative of shut down situation). OH was verified by DNV to be correctly reported /2/.
CL_n Campaign length of project campaign	**FT-111**	Campaign 13: 25 757 t HNO_3 Campaign 14: 16 531 t HNO_3 Campaign 15: 5 628 t HNO_3	The monitoring equipment is as described for the parameter NAP above.
EF_n Emission factor for project campaign $tN_2O/t\ HNO_3$	N/A	Campaign 13: 0.000685 Campaign 14: 0.000417 Campaign 15: 0.000231	The value has been calculated from monitoring data using the algorithm described in N.DBMS /3/. The calculations are exported to an excel file /2/. The spreadsheet calculations have been checked and found to be correct. Hourly raw data was also made available for verification.
$GS_{project}$ Gauze supplier for the project campaign	N/A	W.C. Heraeus	Invoices were made available for verification of the catalyst supplier /13/. Supplier of primary catalyst is W.C. Heraeus.
$GC_{project}$ Gauze composition for the project campaign	N/A	Campaign 13: Platinum (Pt) 59.98% Rhodium (Rh) 3.91% Palladium (Pd) 36.11% Campaign 14:	The composition used in the project campaigns PC13, PC14 and PC15 was verified from the receipts from the catalyst supplier available for verification /13/. DNV confirms that the composition does not have any significant difference from that used in the baseline and historical campaigns.

		Platinum (Pt) 60.01% Rhodium (Rh) 3.91% Palladium (Pd) 36.08% Campaign 15: Platinum (Pt) 59.74% Rhodium (Rh) 3.90% Palladium (Pd) 36.36%	
OT_h (°C) Oxidation Temperature for each hour	**TC-102-A** **TC-102-B** **TC-102-C** **TC-102-D**	N/A	The parameter OT_h is monitored in order to determine when the plant was operating outside of OT_{normal} during the baseline campaign (see section 3.7.1). The parameter is also used to check if the plant is in operation during the project campaigns (if the temperature is below 810°C, the plant is considered to be shut down). This criterion is then used to calculate the operating hours (OH) of the plant. Refer to Appendix C for details on monitoring instruments and calibration routines.
OP_h (Pa-gauge) Oxidation Pressure for each hour	**PT-100**	N/A	The parameter OP_h is monitored in order to determine when the plant was operating outside of OP_{normal} and is only applicable for the baseline campaign, see section 3.7.1.
AFR (t NH_3/h) Ammonia gas flow rate to the ammonia oxidation reactor.	**FT101**	N/A	The parameter AFR is monitored in order to determine when the plant was operating outside of AFR_{max} and is only applicable for the baseline campaign, see section 3.7.1.
AIFR (% v/v) Ammonia to air ratio	N/A	N/A	The parameter AIFR is monitored in order to determine when the plant was operating outside of $AIFR_{max}$ and is only applicable for the baseline campaign, see 3.7.1.

3.7.4 Monitored data for baseline emissions within the project boundary

The verification of the baseline campaign data (campaign H15, from 5 September 2007 to 6 November 2007) and the determination of the baseline campaign emission factor were included in the scope of the verifying DOE /30/. As per the methodology, 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_{BL} (subject to the elimination of data from the operating limits analysis). However, if $CL_n < CL_{normal}$, 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 length of project campaign PC13 (25 757 t100% HNO_3) is longer than the average historical campaign length, CL_{normal} (24 026.2 t100% HNO_3) as well as the baseline campaign length CL_{BL} (17 718 t100% HNO_3), therefore, the regular baseline emission factor EF_{BL} of 0.00564 $tN_2O/tHNO_3$ verified during the first verification /29/ is applied for this campaign without recalculation. Meanwhile, the length of project campaign PC14 (16 531 t100% HNO_3) and PC15 (5 628 t100% HNO_3) are shorter than the average historical campaign length, CL_{normal} (24 026.2 t100% HNO_3) as well as the baseline campaign length, CL_{BL} (17 718 t100% HNO_3), therefore EF_{BL} for PC14 and PC15 are recalculated by eliminating those N_2O values that were obtained during the production of tonnes of nitric acid beyond CL_{BL} for each campaign. DNV has checked the recalculation of baseline presented in the ER calculation sheet /2/ and confirms that it has been executed correctly as per the methodology.

The results from the QAL 2 tests have been provided /5/. The QAL 2 tests are performed as per EN14181 and confirm the determination of the overall uncertainty used in the calculation of the baseline emission factor.

The following table presents data used for determination of baseline. Equipments and related documentations were assessed as part of the first verification /29/. Further details on each monitoring parameter are given in Appendix C:

Data variable	Tag. No.	Value applicable for Project Campaigns	Assessment / Observation
VSG_{BC} Normal gas volume flow rate of the stack gas during baseline	**FT-200**	**PC13, PC14 and PC15:** 42 983 Nm^3/h	See comments in 3.7.3 VSG_{BC} was verified by DNV to be correctly reported /29/. The measurement range of the flow meter is appropriate and the measured average flow rate is within the range expected for a nitric acid plant with a capacity of 292.112 metric tonnes per day. The calibration is performed as per the monitoring plan in the registered PDD and is documented /16/. Refer to Appendix C for details on monitoring instruments and calibration routines.

			DNV can confirm the correction factor determined in QAL 2 /5/ for VSG was retroactively and correctly applied to the data for VSG monitored during the baseline campaign /23/.
$NCSG_{BC}$ N_2O concentration in the stack gas (mgN_2O/Nm^3 converted from ppm)	**AT-110**	**PC13** 1 764.44 mg/Nm^3 **PC14** 1 757.83 mg/Nm^3 **PC15** 1 441.02 mg/Nm^3	See comments in 3.7.3 $NCSG_{BC}$ for PC13, PC14 and PC15 is calculated correctly /29/. Since PC14 and PC15 are shorter than CL_{normal} and CL_{BL}, the values of $NCSG_{BC}$ for PC14 and PC15 have been recalculated as described at the start of this section. DNV has confirmed the correct recalculation of $NCSG_{BC}$ value for both PC14 and PC15. The calibration is performed as per the monitoring plan in the registered PDD and is documented /5/. Refer to Appendix C for details on monitoring instruments and calibration routines. DNV can confirm the correction factor determined in QAL2 for NCSG /5/ was retroactively and correctly applied to the data for NCSG value monitored during the baseline campaign /23/.
OH_{BC} Operating hours of the plant	N/A	1 474 h	See comments in 3.7.3 OH_{BC} was verified by DNV to be correctly reported /29/.
NAP_{BC} t HNO3 Nitric acid 100% concentrated produced over a project campaign	**FT-111**	17 718 t/HNO_3	See comments in 3.7.3 NAP_{BC} was verified by DNV to be correctly reported /5/. Refer to Appendix C for details on monitoring instruments and calibration routines.
EF_{BL} Emission factor for baseline period $tN_2O/t\ HNO_3$	N/A	**PC13** 0.00564 t N_2O/ t HNO_3 **PC14** 0.00562 t N_2O/ t HNO_3 **PC15**	EF_{BL} was verified by DNV to be correctly calculated and reported according to EB 51 Annex 12 (for PC14 and PC 15) /2/. For PC13, the regular EF_{BL} verified during the 1st verification period is correctly applied /29/.

		0.00461 t N_2O/ t HNO_3	
AFR Ammonia gas flow rate to the AOR	**FT101**	Available in excel sheets /2/	AFR is continuously monitored. $NCSG_{BL}$ and VSG_{BL} values monitored when AFR is exceeding AFR_{max} are excluded prior to the calculation of the average values for $NCSG_{BL}$ and VSG_{BL} /2/. Refer to Appendix C for details on monitoring instruments and calibration routines. Calibration certificates were checked by DNV during the first verification and it was confirmed that the calibration results are OK /29/. The calibration is valid for the entire period for the baseline campaign /16/.
AIFR Ammonia to Air Ration	**FT-100** (air flow) **FT-101** (NH_3 flow)	Available in excel sheets /2/	AIFR is calculated from results of AFR (Tag No.: FT101) and Primary Air flow rate (Tag No.: FT100). $NCSG_{BL}$ and VSG_{BL} values monitored when AIFR is exceeding $AIFR_{max}$ are excluded prior to the calculation of the average values for $NCSG_{BL}$ and VSG_{BL} /2/. Refer to Appendix C for details on monitoring instruments and calibration routines. Calibration certificates were checked by DNV during the first verification and it was confirmed that the calibration results are OK /29/. The calibration is valid for the entire period for the baseline campaign /16/.
OT_h Oxidation temperature for each hour	**TC102-A** **TC102-B** **TC102-C** **TC102-D**	Available in excel sheets /2/	OT_h is monitored hourly. $NCSG_{BL}$ and VSG_{BL} values monitored when OT_h is outside the permitted operating range are excluded prior to the calculation of the average values for $NCSG_{BL}$ and VSG_{BL} /2/. Refer to Appendix C for details on calibration routines. Calibration certificates were checked by DNV during the first verification and it was confirmed that the calibration results are OK /29/. The calibration is valid the entire period for the baseline campaign /16/.

OP_h Oxidation Pressure for each hour	**PT-100**	Available in excel sheets /2/	OP_h is monitored hourly. $NCSG_{BL}$ and VSG_{BL} values monitored when OP_h is outside the permitted operating range are excluded prior to the calculation of the average values for $NCSG_{BL}$ and VSG_{BL} /2/. Refer to Appendix C for details on monitoring instruments and calibration routines. Calibration certificates were checked by DNV during the first verification and it was confirmed that the calibration results are OK /29/. The calibration is valid the entire period for the baseline campaign /16/.
GS_{BL} Gauze supplier for baseline campaign	N/A	W.C. Heraues	Verified by validating DOE /30/.
GC_{BL} Gauze composition for baseline campaign	N/A	59% Pt 4% Rh 37% Pd	Verified by validating DOE /30/.

3.7.5 Other factors and calculated parameters

The following parameters are used in the calculation of emissions reductions or are parameters needed to be reported in relation to regulation of N_2O emissions. The verification team has manually checked the calculated values by using the raw data and found the parameters to be correctly reported. Other data for the required parameter according to AM0034 and the source of data was checked.

Data variable	Reported value	Assessment/ Observation
UNC	**4.2 %**	The overall uncertainties for the AMS have been reported in the QAL 2 report /5/.

$EF_{ma,n}$ Moving average emission factor derived over the time from campaign specific emission factors. $tN_2O/t\ HNO_3$	**PC13: 0.001207** **PC14: 0.001150** **PC15: 0.001089**	The moving average is calculated as the average of EF_n from all the previous campaigns (including the campaign n in this monitoring period) as: $EF_{ma,n} = (EF_1 + EF_2 + \ldots + EF_n) / n$ $(tN_2O/tHNO_3)$ DNV has verified the emission factors' data for previous campaigns /29/ and confirms that $EF_{ma,n}$ has been correctly calculated.
EF_{min} The lowest of EFn observed during the first ten campaigns of the project crediting period. $tN_2O/t\ HNO_3$	**0.000267**	The value of EF_{min} was verified from the emission factors for all the previous project campaigns (reported in the previous verification reports) /29/. Emission factors EF_n for PC13 (0.000685 $tN_2O/tHNO_3$) and PC14 (0.000417 $tN_2O/tHNO_3$) are higher than EF_{min}, while for PC15 it is (0.000231 tN2O/tHNO3). Since the EFma,n are all higer than EFmin and EFn, there is no need to use EFmin.
EF_p Emmision factor used for the specific campaign n $tN_2O/t\ HNO_3$	**PC13: 0.001207** **PC14: 0.001150** **PC15: 0.001089**	As required by the methodology AM0034 version 02, the higher of the two values of $EF_{ma,n}$ and EF_n has correctly been used to calculate emission reductions /2/. For PC13: $EF_{ma,n}$ (1.207KgN_2O/t HNO_3) > EF_n (0.685 KgN_2O/t HNO_3) Therefore, $EF_p = EF_{ma,n}$ (1.207KgN_2O/t HNO_3) For PC14: $EF_{ma,n}$ (1.15KgN_2O/t HNO_3) > EF_n (0.417KgN_2O/t HNO_3) Therefore, $EF_p = EF_{ma,n}$ (1.15KgN_2O/t HNO_3) For PC15: $EF_{ma,n}$ (1.089KgN_2O/t HNO_3) > EF_n (0.231KgN_2O/t HNO_3) Therefore, $EF_p = EF_{ma,n}$ (1.089KgN_2O/t HNO_3)
EF_{reg} National regulation on N_2O emissions	**No regulation**	It was confirmed at the site visit that there is no N_2O regulation in South Africa /24/. This parameter is reported in the monitoring report in D.1 and D.2. The N_2O regulation is followed up during the project campaigns and included in the monitoring report. Further African Explosives Ltd has included procedure for following up on any new regulations in its ISO 14001 systems /15/.

NO_x regulation	-	At the site visit, the NO_x concentration was observed to be below the regulation limit of 400 ppm set by the Ministry of Environmental Protection /24/.

3.7.6 Emissions outside the project boundary and leakages

There are no additional emissions to be recorded outside the project boundary or any leakages related to the project activity.

3.8 Quality of evidence to determine emission reductions

The main monitoring parameters are automatically collected by the monitoring system. The raw data are stored as 2 second values at two different locations. All necessary documentation is collected, referenced and aggregated and is easily accessible in spread sheets generated by N.DBMS (N.serve Database Management System). Access to hourly raw data was made available to DNV /2/ in order to check the data presented through the N.DBMS. In order to cross check the results of the database calculation are also incorporated in the spreadsheet /2/. DNV verified the calculations and no deviations were found compared with the results of the database.

Measurements are performed by calibrated equipment /8//17/ and calibrations are valid both for the baseline campaign and the current monitoring period /5//8//10//16//17/. The key data has also been cross-checked via other sources, such as control room stations and on-site meters. In the incident of AMS downtimes during the monitoring period, the NCSG values were excluded from the raw data as per the methodology. No assumptions are used, that have any influence on reported emission reductions.

The project participants have provided excel sheets containing the raw data and calculations for the campaign no. PC13, PC14 and PC15 /2/. These datasheets were verified by DNV and DNV confirms the calculations of baseline emissions and project emissions have been carried out in accordance with the formulae and methods described in the monitoring plan and applied methodology. As per the methodology, AM0034 version 2, no leakage calculation is required.

The calculations of the emission reduction in the spreadsheets and the monitoring report for the monitoring period were checked by DNV and found to be correct, with details as below:

1) The hourly means of N_2O concentration and gas flow in the stack gas were calculated correctly, with correct application of 95% confidence interval; and total N_2O emissions of the project campaign were calculated correctly. Correction factors of 1.02 for gas flow rate and 0.970 for N_2O concentration were applied correctly to the mean values /2/.
2) The nitric acid productions (100% HNO_3) for the baseline and project campaigns covered in the verification period were calculated correctly. The number of hours of operation in each project campaign covered in the verification period was also correctly calculated.
3) The project emission factor was correctly calculated by correct calculations and comparison of a campaign specific emission factor.

4) The baseline emission factor was correctly determined by comparing the campaign length with the average historic campaign length, and subsequently determining the corresponding baseline emission factor.
5) Any N_2O values measured during hours where the plant operated outside the permitted ranges was excluded from the calculation of the baseline emission factor.
6) The emission reductions were then correctly calculated with consideration if the design capacity was exceeded in the specific project campaign.

There is limited uncertainty related to manual transfer of data used in the calculation of emission reduction since the monitored parameters are collected by the automated measurement system.

The calculation of the emission reduction for the monitoring period was checked by DNV and found to be correct.

3.9 Management system and quality assurance

The quality assurance and quality control procedures in terms of equipment operation and maintenance as well as data reporting are covered by documented procedures.

The nitric acid plant AEL9 of African Explosives Ltd. is ISO9001 and ISO14001 certified /14//15/. A CDM procedure is developed for the project activity and incorporated into the quality assurance system /11/. Internal audits are performed twice a year.

Local operators, instrumentation engineers and calibration personnel have been trained by equipment suppliers and qualified internally. Data handling solutions involve redundancy, data manipulation protection, integrity check as well as proper archiving.

For this monitoring system, the quality assurance and control procedure is also according to EN14181 which stipulates three levels:

- QAL1: According to CDM-EB48 report, para 77, "for project activities where the automated monitoring system (AMS) for the measurement of N_2O is subject to compliance with EN14181 as stipulated in the applied methodologies, the Board further clarified that the suitability test QAL1 for the AMS by any entity is acceptable provided that a documentary evidence is submitted which confirms the measures and method conducted are in accordance with the provisions specified in ISO14956". DNV was able to verify that the evaluation has been carried out by TÛV SUD before installation of AMS according to ISO14956 version 1.0, and the evaluation is deemed to be acceptable.[*] /6//7/.
- QAL2: The installed AMS is tested and compared to a SRM. QAL2 test was carried out by TÜV SUD Industrie Services on 7 to 13 February 2008, valid until 6 February 2013 /5/; and latest QAL2 test (including AST) was conducted on 21 to 24 June 2011 by MÜLLER-BBM, valid until 20 June 2016 /8/.
- DNV can confirm the correction factors determined in QAL 2 was correctly applied to

[*] The N_2O analyzers used in this project is the model ABB AO2000 Uras 14 NDIR. ABB has conducted and completed the QAL1 tests for the follow-up model ABB AO2000 Uras 26 of the analyzer module within the same analyzer series (QAL1 Tested by TÜV SÜD) . Since there are no major technical differences between the two analyzer models it is assumed that the analyzers meet the requirements of the QAL1 test in the same way as the follow-up model. A statement was received from ABB where it is stated that the modules Uras 14 and Uras 26 have identical construction for the optical devices and optical filter methods, which is relevant for the technical data in the QAL1 test according to ISO 14956

the data for NCSG and VSG monitored during the project campaign. Further the maximum uncertainty of the AMS (UNC) was correctly applied to the calculation of the baseline emissions factor as per the methodology.

- AST: The latest annual surveillance test was performed on 04 July 2012 and confirmed that operation of the AMS was acceptable and that the calibration functions for NCSG and VSG were still valid and that the requirements for variability are fulfilled /8/.
- QAL3: Span and zero checks are carried out regularly throughout the monitoring period /16/.

4 CERTIFICATION STATEMENT

DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions that have been reported for the CDM project activity 1171 “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” in South Africa for the period 12 March 2012 to 13 March 2013.

The project participants are responsible for the collection of data in accordance with the monitoring plan and the reporting of GHG emissions reductions from the project activity.

It is DNV’s responsibility to express an independent verification statement on the reported GHG emission reductions from the project activity. DNV does not express any opinion on the validated and registered PDD.

DNV conducted the verification on the basis of the baseline and monitoring methodology AM0034 (version 02), the monitoring plan contained in the revised PDD dated 1 July 2014 and the monitoring report (version 03) dated 1 July 2014. The verification included i) checking whether the provisions of the monitoring methodology and the monitoring plan were consistently and appropriately applied and ii) the collection of evidence supporting the reported data.

DNV’s verification approach draws on an understanding of the risks associated with reporting of GHG emission data and the controls in place to mitigate these. DNV planned and performed the verification by obtaining evidence and other information and explanations that DNV considers necessary to give reasonable assurance that reported GHG emission reductions are fairly stated.

In our opinion the GHG emissions reductions reported for the project activity for the period 12 March 2012 to 13 March 2013 are fairly stated in the monitoring report (version 03) dated 1 July 2014.

The GHG emission reductions were calculated correctly on the basis of the approved baseline and monitoring methodology AM0034 (version 02) and the monitoring plan contained in the revised PDD (1 July 2014).

DNV Climate Change Services AS is able to certify that the emission reductions from the CDM project activity 1171 “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” in South Africa during the period 18 April 2012 to 31 December 2012 amount to 48 571 tonnes of CO2 equivalent and the emission reductions during the period 1 January 2013 13 March 2013 amount to 15 251 tonnes of CO2 equivalent.

Oslo, 4 July 2014

Michael Lehmann

Rafi-ud-Din Khawaja
Verifier

Michael Lehmann
Director of Services and Technologies
DNV Climate Change Services AS

5 REFERENCES

Documentation provided by the project participants

/1/ African Explosives Ltd.: *CDM monitoring report for project activity 1171 "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*" for the monitoring period 12 March 2012 to 13 March 2013*, Version 01 dated 22 November 2013 and version 03 dated 1 July 2014

/2/ CDM Project Spreadsheet for the verification period 12 March 2012 to 13 March 2013. Filename:

- *Project 1171 Monitoring period 07 Emission reduction calculation.xlsx*
- *Project 1171 Monitoring period 07 Emission reduction calculation_V02.xlsx*

/3/ Martin Stilkenbäumer, N.serve: "Documentation of N.serve Database Management System for N_2O Destruction CDM Projects"

/4/ Product specification for stack gas flow meter:
The Annubar Flowmeter Series. Product Data Sheet 00813-0100-4809, Rev GA of November 2008

/5/ TÜV SUD Industrie Services QAL 2 report. Author Erhard Krämer. Report no. IS-US3-MUC dated 19 March 2008 (Test conducted from 07.02.2008 to 13.02.2008).

/6/ TÜV SÜD Suitability test report for German Standards, March 2003.

/7/ TÜV SUD QAL1 report Uras 26 (follow-up version of Uras 14), June 2006.

/8/ - MÜLLER-BBM report M92 321/1"Report on performance test (AST) and calibration (QAL2) of continuously operating measuring systems on a nitric acid plant, Nitrates No.9", Report no M92 321/1 dated 21 September 2011 (tests conducted 21-24 June 2011), valid until 20 June 2012 (AST) and 20 June 2016 (QAL2).
- MÜLLER-BBM report M92 321/1"Report on performance test (AST) of continuously operating measuring systems on a nitric acid plant, Nitrates No.9", Report no M100097/01 dated 08 August 2012 (tests conducted 04 July 2012), valid until 03 July 2013

/9/ <u>*Certificates of analysis of calibration test gases during the monitoring period*</u>
Linde: Certificate of analysis for test gas: Nitrous oxide (N_2O): 1080 ppm, Balance: N_2, Uncertainty: +/-2% (used from 10 October 2011 until the end of the monitoring period). Certification date 13 July 2011, valid for 24 months. Cylinder No. 310948.

/10/ QAL3 Calibration reports N_2O analyser ABB AO2040 Uras 14:
- AT-110 N_2O Analyzer Calibration Cell Report from September 2007 (baseline campaign).

/11/ African Explosives Ltd. "Procedure for CDM data preparation" revision 00 of 13.02.2008.

/12/ African Explosives Ltd.: Daily production reports for the period from 12 March 2012 to 13 March 2013

/13/ Heraeus South Africa Ltd. Ammonia Oxidation Catalyst, AEL No.9 Campaigns Confirmation for PC13, PC14 and PC15

/14/ ISO 9001:2008 Certificate number LS 0243 issued by SABS Commercial Ltd. valid until 8 September 2012.

/15/ ISO 14001:2004 Certificate number EM 140394 issued by SABS Commercial Ltd. valid until 3 February 2012.

/16/ African Explosives Ltd.: Calibration certificates for the baseline campaign

Calibration certificates for stack gas parameters by AEL Ltd:

VSG - tail gas flow (FT-200):

Calibration dates: August 2007, November 2007 (exact dates not available). Validity of calibration: 4 months

NCSG - N_2O concentration in the stack gas (AT-110): see reference /5/

TSG – Tail gas temperature (TE-120):

Calibration dates: August 2007, November 2007 (exact dates not available). Validity of calibration: 1 year

PSG- Tail gas pressure (PT-200):

Calibration dates: August 2007, November 2007 (exact dates not available). Validity of calibration: 1 year

Nitric acid flow meter (FT-111):

- ALPRET Controls Specialists: Nitric acid flow meter Tag. No. FT-111. Date 04.01.2007. Valid until 03.01.2010

Calibration certificates for AOR parameters equipment by AEL Ltd:

AFR - Ammonia gas flow rate (FT-101):

Calibration dates: 04 Sept.2007 and 10 Feb. 2008. Valid until 9 Sept. 2008.

AIFR - Ammonia to Air (calculated from ammonia gas flow rate and air flow to AOR), FT-100 (air flow):

Calibration dates: 04 Sept.2007 and 10 Feb. 2008. Valid until 9 Sept. 2008.

OTh – Oxidation temperature (TC102-A, TC102-B, TC102-C, TC102):

Calibration dates: 04 Sept.2007 and 10 Feb. 2008. Valid until 9 June 2008.

OPh – Oxidation pressure (PT-100):

Calibration dates: 04 Sept.2007 and 10 Feb. 2008. Valid until 9 Sept. 2008

/17/ Calibration Certificates relevant for the current monitoring period:

VSG - tail gas flow (FT-200):

- Calibration dates: 15 June 2011, 1 November 2011 and 12 April 2012. Validity of calibration: 7 months (calibration is usually done at the end of each campaign)

NCSG - N_2O concentration in the stack gas (AT-110):

- QAL3 tests done weekly or every 2 weeks from the period 12 March 2012 to 13 March 2013

TSG – Tail gas temperature (TE-120):

- Calibration dates: 15 June 2011, 1 November 2011 and 12 April 2012. Validity of calibration: 7 months (calibration is usually done at the end of each campaign)

PSG- Tail gas pressure (PT-200):

- Calibration dates: 15 June 2011, 1 November 2011 and 12 April 2012. Validity of calibration: 7 months (calibration is usually done at the end of each campaign)

Calibration certificates for Nitric acid flow meter (FT-111):

- FLEXIM Calibration Certificate (No. 20110311-005): Nitric acid flow meter Tag. No. FT-111. Dated 26 November 2011 Valid for 5 years until 25 November 2016

as per ‘‘TIFLUXUS_CalibrationRecommendationV1-1EN’’.
Calibration certificates for AOR parameters equipment by AEL Ltd (Calibration is done only during the plant shut down between two campaign)**:**
AFR - Ammonia gas flow rate (FT-101):
Calibration dates: 22 July 2011, 1 February 2012 and 12 April 2012.
AIFR - Ammonia to Air (calculated from ammonia gas flow rate and air flow to AOR), FT-100 (air flow):
Calibration dates: 22 July 2011, 1 February 2012 and 12 April 2012.
OTh – Oxidation temperature (TC102-A, TC102-B, TC102-C, TC102):
Calibration dates: 25 July 2011, 1 November 2011, 1 February 2012, 12 April 2012.
OPh – Oxidation pressure (PT-100):
Calibration dates: 22 July 2011, 1 February 2012 and 12 April 2012.

/18/ CDM Operation Training – Certificate by AEL Ltd.:
- Certificate of Competence of Mr. Y. Jacobs number 7504185108085 dated 10 December 2009
- Certificate of Competence of Mr. P. Scutte number 5004165045086 dated 10 December 2009
- Certificate of Competence of Mr. P. De Villiers number 4703085070089 dated 10 December 2009
- Certificate of Competence of Mr. J. Gavin number 7307195028081 dated 10 December 2009

  Certificate of Competence of Mr. D. Maseko number 7009305527081 dated 10 December 2009

/19/ DAP (Deutsches Akkreditierungssystem Prüfwesen GmbH: TÜV SÜD Accreditation for ISO 17025:2005 dated 13 July 2007. DAP registration number DAP-PL-2885.80. Valid until 22 May 2011.

/20/ Republic of South Africa – Department of Environmental Affairs and Tourism - Atmosphere pollution prevention Act 1965 (Act 45 of 1965).

/21/ Republic of South Africa – Department of Environmental Affairs and Tourism – Registration certificate of African Explosives Limited (No. 11 Nitric acid) under Atmosphere pollution prevention Act 1965 (Act 45 of 1965) dated 12 December 2003. Certificate no: 135/11

/22/ Route Calibration Services: Calibration certificate No. S 110. Dated 31.07.2009 (uncertainty of nitric acid flow meter).

/23/ CDM Project Spreadsheets for the verification period 05 November 2007 to 10 February 2010, including baseline campaign data:
AEL 9_PC_No1_Calc_V8b_MS_100708.xls

/24/ Republic of South Africa – Department of Environmental Affairs and Tourism - Atmosphere pollution prevention Act 1965 of December 2003.

/25/ AEL Ltd: Procedure for Nitric acid production determination, revision 00 dated 13 February 2009

/26/ African Explosives Ltd.: Calibration Certificate for Ultrasonic Flexim Flow Meter dated 11 March 2011.

/27/ FLEXIM: Technical Information, TIFLUXUS_CalibrationRecommendationV1-1EN

Other project documents or documents used by DNV to verify the information provided by the project participants

/28/ *CDM-PDD for project activity "*Project for the catalytic reduction of N2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa, version 2.0 of 5 April 2007 updated version 3.0 dated 1 July 2014

/29/ DNV Climate Change Services AS: *Verification / Certification report for project activity 1171 "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*:*

- Report no. 2010-0900 version 02 dated 30 May 2012, monitoring period 5 November 2007 to 10 February 2008
- Report no. 2010-9065, version 03 dated 20 June 2012, monitoring period 11 February 2008 to 04 August 2009
- Report no 2011-1256 version 01 dated 30 August 2012, monitoring period 5 August 2009 to 1 July 2010
- Report no 2012-0986 version 01 dated 29 August 2012, monitoring period 2 July 2010 to 15 April 2011
- Report no 2012-1137 version 01 dated 17 September 2012, monitoring period 16 April 2011 to 14 July 2012
- Report no 2012-1317 version 01 dated 19 October 2012, monitoring period 15 July 2011 to 11 March 2012

/30/ Validation report by TÜV SUD: "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", report no. 912444, 10 May 2007.

Methodologies, tools and other guidance by the CDM Executive Board

/31/ CDM Executive Board: *Clean Development Mechanism Validation and Verification Standard*, version 05.0

/32/ CDM Executive Board: *Clean Development Mechanism Project Standard*, version 05.0

/33/ CDM Executive Board: *Clean Development Mechanism Project Cycle Procedure*, version 05.0

/34/ CDM Executive Board: *Baseline and monitoring methodology AM0034*, version 02

Persons interviewed during the verification

/35/ Hendrik Burger, Production Manager Nitrates, African Explosives Ltd.

/36/ Thembeka Lucy Dhlodhlo, Production Technical Services Nitrates, African Explosives Ltd.

/37/ Martin Stilkenbaumer, Project manager and Monitoring Expert, N.serve Environmental Services GmbH
Project was followed by by Niko Gutknecht-Stoehr of N.serve Environmental Services GmbH since 10 January 2014 after Martin Stilkenbaumer left N.serve

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APPENDIX A

CORRECTIVE ACTION REQUESTS, CLARIFICATION REQUESTS AND FORWARD ACTION REQUESTS

Corrective action requests

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 1	For AEL 9, NAP flow meter was changed from Coriolis to Mass flow meter (Ultrasonic flexim flow meter) at the start of the monitoring period. The MR is still referring to Coriolis as the applied flow meter in the monitoring period. The NAP monitoring practice as described in the PDD has been permanently changed since the start of this monitoring period, thus changes to the PDD are needed which will be submitted as post registration changes in the PDD along with this issuance request. Hence, error and uncertainty for flexim flow meter and frequency of calibration recommended by the manufacturer needs to be provided as well (needed for our validation opinion). DNV has confirmed that the calibration of the Flexim Ultrasonic flow meter was done 11 March 2011.	The MR has been updated and now refers to the new NAP flow meter. The specific uncertainty is 1%, the relative error is 0.08%. The manufacturer recommends carrying out a calibration every five years. A PDD to be submitted for post registration changes in the PDD has been provided to the DOE.	MR has been updated reflecting the actual monitoring situation along with updating the PDD. The updated PDD is submitted along with the issuance request as post registration changes (PRC). The new Ultrasonic flexim flow meter was calibrated /26/ on 11 March 2011 (just before the start of the monitoring period). As per the manufacturer recommendation /27/ calibration is required every 5 years. This CAR is closed.

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 2	The following typos need to be corrected in the MRs: - For AEL 9, the gauze composition for campaign 14 for Pd is stated as 36.38%while the value confirmed was 36.08%. - For AEL 9 start date of campaign 13 was confirmed to be 20 Jun 2012, while the MR has 19 Jun 2012 on page 2. Similarly for campaign 14 start date needs to be changed from 12 Oct 12 to 13 Oct 12 and for campaign 15 end date needs to be changed from 13 Mar 13 to 11 Mar 13.	Corrections are made in the AEL 9 MR.	- OK corrections checked and confirmed in the updated MR version 03 of 1 July 2014. - OK corrections checked and confirmed in the updated MR version 03 of 1 July 2014. This CAR is closed.
CAR 3	For AEL 9, for QAL 3 delays corrections have been applied from 11 Feb 2013 to 11 Mar 2013. It also needs to be applied for the period from 05 Feb 2013 to 10 Feb 2013.	Corrections are made in the AEL 9 Calculation and MR.	Corrections due to QAL 3 delays have been applied from 05 Feb 2013 to 11 Mar 2013 in the PC14 and PC15 campaigns data and cross cheked and confirmed from the updated spreadsheet V02 /2/. This CAR is closed.
CAR 4	For AEL 9, NAP value needs to be corrected from 387 to 310 for 21 June 2012 in the spreadsheet as found during data sampling.	Corrections are made in the AEL 9 Calculation and MR.	OK corrections checked and confirmed in the updated version 03 of MR dated 1 July 2014. . This CAR is closed.

Clarification requests

CL ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CL 1	For AEL 9 uncertainty for N_2O concentration as per QAL 2 is applied for delayed calibrations. Further explanations as discussed during the onsite interviews need to be provided and corresponding edits and explanations need to be included in the MR. Further, it should be explained how these values are selected as the highest of the instrument uncertainty and the calibration errors.	The measurement uncertainty of the AMS as calculated as a result of several components and influence factors in the QAL1 test is 2,64 % (TÜV SÜD report 691317 from 30.06.2006; cited in TÜV SÜD QAL2 report 1116706, Appendix N2O page 12). The measurement uncertainty as calculated during the initial QAL 2 test in 2008 is 2.69 %. This value is deemed to be the maximum permissible error. (TÜV SÜD report 1116706, page 9). During the delayed AST test in 2012, it was concluded that all requirements regarding measurement uncertainty are fulfilled and the tests of variability and validity are passed. Therefore it can be concluded that the instrument showed no errors during delayed calibration according to EB 52 annex 60 and the maximum permissible error as described above (2.69 %) needs to be applied to the measurement value (Müller-BBM report M100097/01).	Since the instrument showed no errors during delayed calibration /8/, applying the maximum permissible error of 2.69% as per TÜV SÜD report 1116706 is considered OK by DNV. This CL is closed.

CL ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CL 2	For AEL 9 uncertainty for stack gas flow as per QAL 2 is applied for delayed calibrations. Further explanations as discussed during the onsite interviews need to be provided and corresponding edits and explanations need to be included in the MR. Further, it should be explained how these values are selected as the highest of the instrument uncertainty and the calibration errors.	The measurement uncertainty of the AMS as calculated by the supplier 2,50 % (Emmerson Engineering Report ER-5396 from August 9, 2006 page 8). The measurement uncertainty as calculated during the initial QAL 2 test in 2008 is 3,22 %. This value is deemed to be the maximum permissible error. (TÜV SÜD report 1116706, page 10). During the delayed AST test in 2012, it was concluded that all requirements regarding measurement uncertainty are fulfilled and the tests of variability and validity are passed. Therefore it can be concluded that the instrument showed no errors during delayed calibration according to EB 52 annex 60 and the maximum permissible error as described above (3.22 %) needs to be applied to the measurement value (Müller-BBM report M100097/01).	Since the instrument showed no errors during delayed calibration /8/, applying the maximum permissible error of 3.22% as per TÜV SÜD report 1116706 is considered OK by DNV. Further, DNV has confirmed and checked applying corrections to the data from updated spreadsheets /2/. This CL is closed.

Forward action requests from previous verification

FAR ID	Forward action request	Summary of how FAR has been addressed in this reporting period	Assessment of how FAR has been addressed
FAR 1	NA	NA	NA

Forward action requests from this verification

FAR ID	Forward action request	Response by Project Participants
FAR 1	Calibration certificate for NH_3 flow for 8 august is stating two different values for flow i.e. 26.13 Pa (which is equal to 3500 m^3/hr) and 4950 m^3/hr. This difference has resulted due to the wrong formula in the form and thus needs to be corrected by updating the format for the certificate.	The format of the certificate will be updated by correcting the wrong formula. The new version will be presented to the verifying DOE during the next verification site visit.

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APPENDIX B

POST REGISTRATION CHANGES

Type of post registration change	**Description of post registration change***	**Is prior approval by CDM EB required**?**	**In case prior approval by CDM EB is required, when was post registration change approved?**
Corrections	No applicable.	☐ Yes ☐ No ☒ Not applicable	No applicable.
Temporary deviations from the registered monitoring plan and/or monitoring methodology	Not applicable.	☐ Yes ☐ No ☒ Not applicable	No applicable.
Permanent changes from the registered monitoring plan or applied methodology	The NAP in $tHNO_3$ (metric tonnes of 100% concentrated nitric acid during each project campaign) as per PDD version 2.0 of 05 April 2007 is monitored by mass balance calculation and flow measurements. A detailed method is given in the version 2.0 of the PDD for mass balance calculations where delivery volumes are measured by flow meter. The AEL 9 plant has a coriolis flow meter installed at the nitric acid product outlet before it goes into the production storage tank to determined mass of nitric acid produced. However, the Flexim Ultrasonic flow meter has been installed since 02 August 2011 in parallel to the Coriolis mass flow meter, initially for testing purposes. However, from the start of the first project campaign of the monitoring period (PC13) on 20 June 2012 and thus for the entire monitoring period from 12 March 2012 to 13 March 2013, the values from the new ultrasonic flow meter were recorded and utilized for NAP.	☐ Yes ☒ No ☐ Not applicable	Prior approval by CDM EB not required.
Changes to the project design of a registered project activity	Not applicable.	☐ Yes ☐ No ☒ Not applicable	Not applicable

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APPENDIX C

VERIFICATION MONITORING PARAMETERS

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**NAP** Nitric acid 100% concentrated produced over a baseline campaign/project campaign
Measuring frequency:	Continuously
Reporting frequency:	Every Hour
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag.No.	Mass Flow Meter – Micro Motion CMF200 during baseline campaign and Flexim Ultrasonic flow meter during project campaigns. TAG: FT-111
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the monitoring is not stated in the PDD. The monitoring equipment (Coriolis mass flow meter as well as Flexim Ultrasonic flow meter) are common practices for measuring nitric acid and measurement uncertainty for both are <= 0.1 % of measured flow rate (as per the supplier).
Calibration frequency /interval:	Every three years for Coriolis and every 5 years for Flexim Ultrasonic flow
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Yes. Meters are calibrated as per ISO 9001 Procedure no C09NA revision 1 “Calibration Procedures” of African Explosives Ltd.
Company performing the calibration:	Alpret Control Specialists Ltd. for Coriolis mass flow meter and FLEXIM for Flexim Ultrasonic flow meter
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	Yes Date of last calibration: 11 March 2011 valid until 10 March 2014

If applicable, has the reported data been cross-checked with other available data?	The data has been cross checked with NAP data from mass balance method /25/.
How were the values in the monitoring report verified?	DNV performed samples checks of production log books
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK, all activities are regulated by QA/QC Procedures. The data are automatically transferred and stored in the plant's process control system. All data necessary for the emission reduction calculation are manually transferred to the dedicated relational database management system (N.DBMS) and excel calculations spreadsheets. DNV checked the raw data from the PCs and no error was found.
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	NA

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**NCSG** N_2O concentration in the stack gas
Measuring frequency:	Continuously
Reporting frequency:	Every 2 seconds
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag.No.	ABB AO2040 Uras 14 TAG no AT-110
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the N_2O analyser was not stated in the PDD as the installed analyser at the time of validation was a S.A. MIR 9000 analyser. However, a new analyser ABB AO2040 Uras 14 was installed in May 2007. The installed analyzer ABB AO2040 Uras 14 is widely used to measure N_2O concentration and have also passed QAL1 /7/. The ABB AO2040 Uras 14 was used during the baseline and project campaigns. The measurement

	accuracy was determined to be 2.69% as per first QAL 2 report /5/ , and considered still valid in the latest QAL2 report /8/.
Calibration frequency /interval:	**Internal calibration**s: Done bi-weekly. Zero and span check. Calibration is done in case a deviation of > 1% of analyzer range is observed. Analyzer is calibrated as per ISO 9001 Procedure no C09NA revision 1 “Calibration Procedures” of African Explosives Ltd. **External calibration:** QAL 2 by an authorized ISO 17025 institute every 5 years, AST test every year in between QAL 2 test /8/. **QAL2 tests:** • QAL2 test (including AST) by MÜLLER-BBM GmbH on 21-24 June 2011/8/, valid until 20 June 2016 • QAL2 tests by TÜV SUD Industrie Services on 7-13 February 2008. Report dated 19 March 2008 /5/, valid until 6 February 2013. **AST tests:** • Müller-BBM GmbH on 04 July 2012, report dated 08 August 2012 /8/, valid until 03 July 2013. • Müller-BBM GmbH on 21-24 June 2011, report dated 21 September 2011 /8/, valid until 20 June 2012.
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Yes
Company performing the calibration:	Internal calibration by AEL Nitrates Instrumentation Department /16//17/. First QAL2 by TÜV SUD Industrie Services /5/ /19/. Later QAL2 and AST by Müller-BBM GmbH /8/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes

Is(are) calibration(s) valid for the whole reporting period?	Yes. The latest QAL2 test is valid until 20 June 2016 and AST is valid until 03 July 2013 /8/. The zero and span checks were performed bi-weekly as specified in AEL internal procedure /11/.
If applicable, has the reported data been cross-checked with other available data?	The data are cross-checked with the concentration measurement by a SRM during the QAL 2 test /8/.
How were the values in the monitoring report verified?	Raw data from the monitoring period were provided and checked by DNV /2/. Random picked data points were checked against data stored on the monitoring PC.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK, all activities are regulated by QA/QC Procedures. The data are automatically stored in the SCADA Data Acquisition System. Once a month the results will be downloaded from SCADA to an excel file for analysis and calculation. The raw data will be saved on a DAT device and will be stored in a strongbox in the IT office. All data necessary for the emission reduction calculation are digitally transferred from the Plant data system (SCADA) to the dedicated relational database management system (N.DBMS).
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	The AST was due on 21 June 2012 (1 year after the last AST). However, AST tests were done on 04 July 2012 /8/. As per para 238 of VVS /31/ the maximum permissible error of the instruments for NCSG was applied for the period from 21 June 2012 to 03 July 2012. DNV confirms that the error was applied in a conservative manner for the period between the scheduled AST test and the actual date of the AST test /2/. Since no span checks were performed for the period 05 February 2013 – 13 March 2013 /10/. As per para 238 of VVS /31/ the maximum permissible error of the instruments for NCSG was applied for the period from 05 February 2013 – 13 March 2013 /2/.

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**TSG** (stack gas temperature)
Measuring frequency:	Every 2 seconds
Reporting frequency:	Hourly average
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag.No.	Thermocouple type PT100_385-3 wire RTD Transmitter: Rosemount Model 644 RAI Tag. No.: TE-120
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The monitoring equipment represents good monitoring practice. Measurement uncertainty: 2.55% as per initial QAL 2 test report/5/, and considered still valid in the latest QAL2 report /8/.
Calibration frequency /interval:	Internal calibration at least once per year, usually every 4 months after each campaign /16//17/. Meter is calibrated as per ISO 9001 Procedure no C09NA revision 1 “Calibration Procedures” of African Explosives Ltd QAL 2 test after every 5 years, and AST test every year in between QAL 2 test. **QAL2 tests:** • QAL2 test (including AST) by MÜLLER-BBM GmbH on 21-24 June 2011/8/, valid until 20 June 2016 • QAL2 tests by TÜV SUD Industrie Services on 7-13 February 2008. Report dated 19 March 2008 /5/, valid until 6 February 2013. **AST tests:** • Müller-BBM GmbH on 04 July 2012, report dated 08

	August 2012 /8/, valid until 03 July 2013. • Müller-BBM GmbH on 21-24 June 2011, report dated 21 September 2011 /8/, valid until 20 June 2012.
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Yes
Company performing the calibration:	Internal calibration by AEL Nitrates Instrumentation Department /16//17/. First QAL2 by TÜV SUD Industrie Services /5/ /19/. Later QAL2 and AST by Müller-BBM GmbH /8/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	Yes. The latest QAL2 test is valid until 20 June 2016 and AST is valid until 03 July 2013 /8/.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Raw data from the monitoring period were provided and checked by DNV. Random picked data points were checked against data stored on the monitoring PC.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK. All activities are regulated by QA/QC Procedures. The data are automatically stored in the SCADA Data Acquisition System. One a month the results will be downloaded from SCADA to an excel file for analysis and calculation. The raw data will be saved on a DAT device and will be stored in a strongbox in the IT office. All data necessary for the emission reduction calculation are digitally transferred from the Plant data system (SCADA) to the dedicated relational database management system (N.DBMS).
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or	NA

has a request for deviation been approved?	

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**PSG** (stack gas pressure)
Measuring frequency:	Every 2 seconds
Reporting frequency:	Hourly average
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag No.	Rosemount pressure probe. Transmitter: Rosemount; type 3051TA1A2B21BB4I1M5Q4 Tag no.: PT-200
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The monitoring equipment represents good monitoring practice. Measurement uncertainty: 0.7% (as per QAL 2 report) /5/.
Calibration frequency /interval:	Internal calibration at least once per year, usually every 4 months after each campaign /16//17/. Meter is calibrated as per ISO 9001 Procedure no C09NA revision 1 “Calibration Procedures” of African Explosives Ltd QAL 2 test after every 5 years, and AST test every year in between QAL 2 test. **QAL2 tests:** • QAL2 test (including AST) by MÜLLER-BBM GmbH on 21-24 June 2011/8/, valid until 20 June 2016 • QAL2 tests by TÜV SUD Industrie Services on 7-13 February 2008. Report dated 19 March 2008 /5/, valid until 6 February 2013.

	AST tests: • Müller-BBM GmbH on 04 July 2012, report dated 08 August 2012 /8/, valid until 03 July 2013. • Müller-BBM GmbH on 21-24 June 2011, report dated 21 September 2011 /8/, valid until 20 June 2012.
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Yes
Company performing the calibration:	Internal calibration by AEL Nitrates Instrumentation Department /16//17/. First QAL2 by TÜV SUD Industrie Services /5/ /19/. Later QAL2 and AST by Müller-BBM GmbH /8/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	Yes. The latest QAL2 test is valid until 20 June 2016 and AST is valid until 03 July 2013 /8/ .
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Raw data from the monitoring period were provided and checked by DNV. Random picked data points were checked against data stored on the monitoring PC.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK. All activities are regulated by QA/QC Procedures. The data are automatically stored in the SCADA Data Acquisition System. One a month the results will be downloaded from SCADA to an excel file for analysis and calculation. The raw data will be saved on a DAT device and will be stored in a strongbox in the IT office. All data necessary for the emission reduction calculation are digitally transferred from the Plant data system (SCADA) to the dedicated relational database management system (N.DBMS).

In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	NA

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**VSG** Stack gas flow
Measuring frequency:	Every 2 seconds
Reporting frequency:	Hourly average
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag No.	Emerson Rosemount Annubar Model 485 with 3051S pressure transmitter TAG no FT-200
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the flow meter was not stated in the PDD. This analyzer is widely used to measure volume flow. Uncertainty is determined in QAL2 to be ± 2.65 % /5/ and considered still valid in the latest QAL2 report /8/.
Calibration frequency /interval:	Internal calibration at least once per year usually every 4 months after each campaign /16//17/. Meter is calibrated as per ISO 9001 Procedure no C09NA revision 1 “Calibration Procedures” of African Explosives Ltd. QAL 2 test after every 5 years /5/, and AST test every year in between QAL 2 test /8/. **QAL2 tests:** • QAL2 test (including AST) by MÜLLER-BBM GmbH on 21-24 June 2011/8/, valid until 20 June 2016 • QAL2 tests by TÜV SUD Industrie Services on 7-13

	February 2008. Report dated 19 March 2008 /5/, valid until 6 February 2013. **AST tests:** • Müller-BBM GmbH on 04 July 2012, report dated 08 August 2012 /8/, valid until 03 July 2013. • Müller-BBM GmbH on 21-24 June 2011, report dated 21 September 2011 /8/, valid until 20 June 2012.
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Yes
Company performing the calibration:	Internal calibration by AEL Nitrates Instrumentation Department /16//17/. First QAL2 by TÜV SUD Industrie Services /5/ /19/. Later QAL2 and AST by Müller-BBM GmbH /8/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	Yes. The latest QAL2 test is valid until 20 June 2016 and AST is valid until 03 July 2013 /8/.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Raw data from the monitoring period were provided and checked by DNV /2/. Random picked data points were checked against data stored on the monitoring PC.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK. All activities are regulated by QA/QC Procedures. The data are automatically stored in the SCADA Data Acquisition System. One a month the results are downloaded from SCADA to an excel file for analysis and calculation. The raw data is saved on a DAT device and is stored in a strongbox in the IT office. All data necessary for the emission reduction calculation are digitally transferred from the Plant data system (SCADA) to the

	dedicated relational database management system (N.DBMS).
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	The AST was due on 21 June 2012 (1 year after the last AST). However, AST tests were done on 04 July 2012 /8/. As per para 238 of VVS /31/ the maximum permissible error of the instruments for VSG was applied for the period from 21 June 2012 to 03 July 2012. The combined error for Stack gas flow, TSG and PSG was applied to the results for VSG. DNV confirms that the error was applied in a conservative manner for the period between the scheduled AST test and the actual date of the AST test /2/.

	Assessment/ Observation
Data / Parameters: (as in monitoring plan of PDD):	**OT_h, OP_h, AFR and AIFR** Note: AIFR is calculated from results of AFR (Tag No.: FT101) and Primary Air flow rate (Tag No.: FT100)
Measuring frequency:	Continuously
Reporting frequency:	Hourly average
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag No.	Thermocouples AOR: Type K-6 Multipoint thermocouple Tag. No.: TC-102-A, TC-102-B, TC-102-C, TC-102-D Pressure AOR: PT-100, Yokogawa type Press Tx Ammonia flowmeter: FT101, Yokogawa type orifice plate with D.P. transmitter Primary Air flow rate: FT100, Yokogawa D.P. transmitter.

Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the monitoring is not stated in the PDD. The measurement accuracy is 1% for thermocouples, 1.7% for oxidation pressure, 1.25% for AFR and 1.66% for AIFR (air flow) as per calibration requirements at AEL. These represent good monitoring practice.
Calibration frequency /interval:	During plant shut down between 2 campaigns (usually once every 6 months)
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Meter is calibrated as per ISO 9001 Procedure no C09NA revision 1 "Calibration Procedures" of African Explosives Ltd.
Company performing the calibration:	African Explosives Ltd.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	Yes. /16//17/
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Raw data from the monitoring period were provided and checked by DNV /2/. Random picked data points were checked against data stored on the monitoring PC.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK. All activities are regulated by QA/QC Procedures. The data are automatically stored in the SCADA Data Acquisition System. Once a month the results will be downloaded from SCADA to an excel file for analysis and calculation. The raw data will be saved on a DAT device and will be stored in a strongbox in the IT office. All data necessary for the emission reduction calculation are digitally transferred from the Plant data system (SCADA) to the dedicated relational database management system (N.DBMS).

In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	NA

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APPENDIX C

CURRICULA VITAE OF THE VERIFICATION TEAM MEMBERS

Rafi-ud-Din Khawaja

Rafi-ud-Din Khawaja holds a Master's Degree in Environmental Engineering with over 10 years of experience in air pollution control technology, air pollution monitoring, risk management reviews (RMR), ambient air quality analysis (AAQA), transport phenomena, urban and industrial air quality management .

He has acquired over six years of experience in validation and verification of numerous CDM and JI projects while working in DNV. He has been qualified as a CDM validator for technical area Renewables (hydro) and as a CDM validator/verifier as well as a Technical Reviewer (TR) for technical area N_2O under the Qualification Scheme of Climate Change Services of DNV.

His qualification, industrial experience and experience in CDM facilitate him to assess all technical areas to sufficient degree.

Trine Kopperud

Trine Kopperud holds a Bachelor First Honours Degree in Chemical and Process Engineering with an overall experience of around 25 years in chemical process industries. Prior to joining DNV she has gained experience from fertiliser production (including ammonia, nitric acid and catalysts production and sales), magnesium production and energy efficiency. Positions in research and operations including 5 year experience in N_2O abatement technologies (research & development, operation, application and sales).

She has experience of more than 6 years in validation and verification of CDM projects/JI in several countries including China, India, Africa, Middle East and Eastern Europe.

Her qualification, industrial experience and experience in CDM/JI demonstrate her sufficient sectoral competence in Chemical Processes Industries TA 5.1/11.1/12.1. and Metal production TA 9.1.

Ravi Kumar Prabhu

Ravi Kumar Prabhu holds Bachelor's Degree in Chemical Engineering and has done Post Graduate Diploma course in Management and has an overall working experience of around twenty five years. Prior to joining DNV has around twenty three years of experience in Chemical process industry (fertilizer & petrochemical manufacturing) covering production, technical services including energy audits and efficiency studies, waste heat recovery, efficiency studies of boilers, power plants, safety audits, pollution control activities and waste water treatment. With respect to the Thermal Power Plant, the job assignment included the monitoring of flue gas stack temperatures and excess air, efficacy of fuel additives, condition of boiler refractory and insulation of steam lines, residual life assessment of boilers etc. His experience also includes 7 years in the Process design of fertilizer & petrochemical plants, wherein he was involved in the development of process flow diagrams, development of P&IDs, equipment design, HAZOP studies, procurement and commissioning activities.

He has six years of experience in validation and verification of CDM projects in DNV and is also an EMS lead auditor. His qualification, industrial experience and experience in CDM projects demonstrate sufficient sectoral competence in Chemical Process Industries (TA 5.1), Thermal Energy Generation from fossil fuels (TA1.1), Heat distribution (TA 2.2), Energy generation from Renewable Energy sources (TA 1.2) and Waste handling and disposal (TA 13.1).

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