VERIFICATION / CERTIFICATION REPORT

"N2O ABATEMENT PROJECT AT NITRIC ACID PLANT NO. 11 AT AFRICAN EXPLOSIVES LTD. (AEL), SOUTH AFRICA"

(UNFCCC Registration Ref. No. 1364)

Monitoring Period:
18 April 2012 to 05 June 2013

REPORT NO. 2014-0069

REVISION NO. 01

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MANAGING RISK

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Verification/certification of project activity "N2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa" in South Africa

For:
African Explosives Ltd.

Account Ref.:
Hendrik Burger

Date of Current Issue:	3 July 2014	ConCert Project No.:	PRJC-494446-2013-CCS-NOR
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Summary:

DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions reported for the project activity "N_2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa" in South Africa" (UNFCCC Registration Ref. No. 1364) for the period 18 April 2012 to 05 June 2013.

In our opinion, the GHG emission reductions reported for the project in the monitoring report (version 04) of 3 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 Project Design Document, version 1.c. of 25 September 2007.

DNV Climate Change Services AS is able to certify that the emission reductions from the project activity "N2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa" in South Africa during the period 18 April 2012 to 05 June 2013 amount to 298 728 tonnes of CO_2 equivalent.

Prepared by:	Verified by:	Approved by:
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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 1364 "N2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa" in South Africa (the project) for the period 18 April 2012 to 05 June 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 "N2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa" for the period 18 April 2012 to 05 June 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:	*N2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa*
UNFCCC registration No:	*1364*
Baseline and monitoring methodology	*AM0034 (version 02)*
Sectoral scope(s):	*5*

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:	*8 Feb 08 to 7 Feb 18 (Fixed)*
Period verified in this verification:	*18 April 2012 to 05 June 2013*

The emission reductions reported from the project for the period from 18 April 2012 to 05 June 2013 amount to 298 728 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 in 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) and records from the production logs of the nitric acid production have been examined and verified for the reporting period.

Verification team

Role	***Last Name***	***First Name***	***Country***	***Type of involvement*** 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 2013 to 3 July 2014

2.1 Desk review

In addition to the monitoring report (version 01 dated 22 November 2013 and version 04 dated 3 July 2014) /1/, DNV reviewed:

- The PDD for the project activity (version 1.c. of 25 September 2007) /24/
- The previous verification report /25/
- Baseline and monitoring methodology AM0034, version 02 /30/

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/ - /23/.

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 (version 1.c. of 25 September 2007) /24/;
- 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 /31/-/33/, 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 /30/ 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 three 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, the following changes to the

monitoring report (version 04 dated 3 July 2014) were made compared to the initial version of the monitoring report received for verification (version 01 dated 22 November 2013):

- on Page 33 of the MR: the amount of NAP for PC 12 was corrected from 127,440.89 to 129,146.39

3 VERIFICATION FINDINGS

This section summarises the findings from the verification of the emission reductions reported for the "N2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa" for the period 18 April 2012 to 05 June 2013.

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

There are no remaining issue (FARs) from the previous verification /25/.

3.2 Post registration changes

There were no post registration changes identified by DNV during this verification.

3.3 Project implementation

As part of the site visit DNV was able to confirm that the project implementation is in accordance with the project description contained in the PDD (version 1.c. of 25 September 2007) /24/.

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. During the on-site visit, the verification team inspected all the field installation and instrumentation necessary for the monitoring of the emission reductions and confirms that the project is completely operational.

The baseline campaign was operated from 20 July 2006 to 18 February 2007. The determination of the permitted operating conditions for operating temperature, operating pressure, maximum ammonia flow rate, maximum ammonia to air ratio, normal campaign length, normal gauze supplier and normal gauze composition was carried out by the validating DOE /26/ while the verification of the baseline campaign as well as the determination of the baseline emission factor was done by DNV during the first verification [*]/25/. Due to the additional costs associated with the installation and operation of secondary catalyst, the project proponents did not want to install the abatement catalyst before the project got registered. This resulted in an intermediate campaign (without N_2O abatement catalyst installed) from 25 February 2007 to 18 August 2007 between the baseline campaign and the first project campaign. DNV finds the justification for the intermediate campaign to be reasonable and in accordance with the clarification to the methodology AM_CLA_0234 issued on 2 August 2012. Also, since the operating parameters OTh, OPh, AFR and AIFR measured during the baseline campaign were within the permitted operating range for more

[*] According to the EB 31 minutes of meeting, either validating or verifying DOE can undertake the task of the determination of the permitted operating conditions for project activities using approved methodology AM0034.

than 50% of the time, the selected baseline campaign is found to be valid and in compliance with the methodology AM0034.

The first project campaign with secondary catalyst installed started on 12 September 2007. The project got registered with UNFCCC on 8 February 2008, which is the starting date of the crediting period.

During this monitoring period three production campaigns were completed:

Campaign PC10	25 April 2012 to 04 October 2012
Campaign PC11	13 October 2012 to 26 November 2012
Campaign PC12	07 December 2012 to 05 June 2013

The details of previous production campaigns are as follows:

Campaign PC1	12 September 2007 to 19 March 2008
Campaign PC2	20 March 2008 to 28 September 2008
Campaign PC3	04 October 2008 to 23 May 2009
Campaign PC4	8 June 2009 to 27 December 2009
Campaign PC5	30 December 2009 to 3 August 2010
Campaign PC6	4 August 2010 to 16 November 2010
Campaign PC7	19 November 2010 to 28 February 2011
Campaign PC8	24 March 2011 to 06 August 2011
Campaign PC9	22 August 2011 to 17 April 2012

By reviewing the production records, DNV can confirm that the list of shutdowns and special events included in the monitoring report /1/ is complete. It was verified by DNV by reviewing the raw data and the ER calculations /2/ as well as the daily production records /10/ that the shutdown periods (relevant hours) are not considered in the overall emission reduction calculations. Furthermore, DNV verified the trend curves for the operation and no other special event were observed.

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

The emission reductions achieved in this monitoring period from 18 April 2012 to 05 June 2013 (i.e. 414 days) are 298 728 tonnes of CO_2 equivalents. The yearly expected emissions reductions according to the registered PDD is 265 460 tonnes of CO_2 equivalents. This corresponds to emission reductions of 301 097 tonnes of CO_2 equivalents in 414 days. Therefore, the actual emission reductions achieved during this monitoring period are lower than those estimated in the PDD. The main reasons for the lower than expected emission reductions are:

Abatement efficiency of approximately 79%, 77% and 78% was achieved for the three campaigns as compared to the 90% assumed in PDD (based on the baseline and project emission factors).

The design capacity of the plant as stated in the PDD is 775 tons of 100% HNO_3. The total production of nitric acid for the current monitoring period from 18 April 2012 to 05 June 2013 (414 days) is 269 904 tons of 100% HNO_3. The corresponding production at design capacity is 320 850 tons of 100% HNO_3. The production during the current monitoring period

is therefore below the design capacity for the plant and is hence fully eligible for emission reduction calculations

3.5 Compliance of monitoring plan with monitoring methodology

DNV is able to confirm that the monitoring plan contained in the PDD (version 1.c. of 25 September 2007) is in accordance with the approved methodology applied by the project activity, i.e. AM0034 (version 02) /30/. Neither a revision nor a deviation to the monitoring plan has been requested to CDM Executive Board.

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 version 1.c. of 25 September 2007 as per the approved monitoring methodology, AM0034, version 02 /30/. 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 /30/.

All parameters stated in the validated monitoring plan and the applied methodology AM0034 version 02 /30/ 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

Historical data and permitted operating conditions were verified by DNV as part of the first verification /25/. The table below summarizes the permitted operating conditions.

Data variable	Reported value
Design capacity	282 875 metric tonnes of 100% HNO_3 per year (775 metric tonnes per day with 365 operating days per year).
OT_{normal}	820°C to 905°C
OP_{normal}	365 kPa to 450 kPa (gauge)

AFR_{max}	9.094 tNH_3/h
$AIFR_{max}$	11.5 %
CL_{normal}	127 302.4 $tHNO_3$
CL_{BL}	134 700 $tHNO_3$
GS_{normal} Gauze supplier for the operation condition campaigns	W.C. Heraeus
GC_{normal} Gauze composition for the operation condition campaigns	Platinum (Pt) 56.5% Rhodium (Rh) 3.8% Palladium (Pd) 39.7%

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 /24/ as per the applied and approved methodology, AM0034 version 02 /30/.

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 provided an additional spreadsheet to DNV containing all the formulae of calculation as required for the determination of emission reductions by the methodology AM0034 (version 02) /2/. Both spread sheets give the exact same results.

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 0 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 PC10, PC11, and PC 12**	**Assessment /Observation**
VSG Normal gas volume flow rate of the stack gas during project	**FT-76550** Range: 0-150 000 Nm³/h	Campaign 10: 81 521 Nm^3/h Campaign 11: 77 010 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.

campaign (Nm^3/h)		Campaign 12: 79 691 Nm^3/h	Specifications of the flow meter are provided /4/. Refer to Appendix C for details on monitoring instrument and calibration routines The combined uncertainty of flow measurement at standard conditions is ± 2.96 % /7/ and the correction factor based on QAL2 report is 0.96 /7/. It was verified that the same value of correction factor is implemented in the data system for adjusting the total stack gas flow during the monitoring period. The measurement range of the flow meter is appropriate. The internal calibration records were also verified by DNV, and covers the whole project campaign (calibration is performed in between campaigns) /14/. The AST was due on 22 June 2012 (1 year after the last AST). However, AST tests were done from 03 to 04 July 2012 /7/. As per para 238 of VVS /27/ the maximum permissible error of the instruments for VSG was applied for the period from 22 June 2012 to 02 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	**PT-76506** Range 0 - 1000 Pa (abs).	The pressure is used for standardization of volume flow rate in the stack	The pressure in the stack gas is measured by a Rosemont pressure probe. Refer to Appendix C for details on monitoring instrument and calibration routines. The overall conclusion in the QAL2 report is that the PSG equipment is suitable to measure the stack gas pressure and that the combined standard uncertainty is ± 0.70% /7/. The internal calibration records /14/ were also verified by DNV, and cover the whole monitoring period.

TSG	**TE-76170** Range: 0-500 ^{o}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. The overall conclusion in the QAL 2 report is that the TSG equipment is suitable to measure the stack gas temperature and that the combined standard uncertainty is ± 2.55 % /7/. The internal calibration records /14/ were also verified by DNV, and covers the whole monitoring period.
NCSG N_2O concentration in the stack gas (mgN_2O/Nm^3)	**AT-76020-2** Range: 0-2000 ppmv	Campaign 10: 271.85 mg N_2O/Nm^3 Campaign 11: 401.61 mg N_2O/Nm^3 Campaign 12: 408.62 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 by ABB type AO2040-Uras14 with a measurement accuracy of 2.69% (for N_2O). The 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 QAL 1 /6/. During the QAL2 performed in February 2008 /7/, the N_2O correction factor was determined to be 0.99. During the QAL2 tests conducted in June 2011, the correction factor remained unchanged /7/. It has been verified that the same value is used for adjusting the N_2O concentration during the monitoring period. Refer to Appendix C for more details on monitoring instrument and calibration routines. The AST was due on 22 June 2012 (1 year after the last AST). However, AST tests were done from 03 - 04 July 2012 /7/. As per para 238 of VVS /27/ the maximum permissible error of the instruments for NCSG was applied for the period from 22 June 2012 to 02 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/. No span checks were performed for the period

			05 February 2013 – 01 May 2013 /8/. As per para 238 of VVS /27/ the maximum permissible error of the instruments for NCSG was applied for the period from 05 February 2013 – 01 May 2013 /2/. Further, for the period 02 May 2013 until 05 June 2013 a wrong span gas value of 1000 ppm instead of 1057 ppm was applied during the span gas checks. Respective corrections were also applied to the monitoring data for this period /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. /9/. The analyser room and equipment is inspected weekly. Weekly check lists and N_2O Maintenance Activities Log Book were made available during the site visit.
NAP t HNO_3 Nitric acid 100% concentrated produced over a project campaign	**FT-76010**	Campaign 10: 109 312 t HNO_3 Campaign 11: 31 445 t HNO_3 Campaign 12: 129 146 t HNO_3	Nitric acid is measured with a mass flow meter Coriolis MicroMotion CMF300 from Emerson. 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 reported by the Coriolis flow meter is cross-checked against other production parameters i.e. ammonia consumption and product stock levels and product consumption and final production figure is reported as per the procedure for nitric acid production determination /20/. 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 Coriolis mass flow meters. The analysis was checked by DNV and found to be appropriate. However, during this monitoring period only flow meter values were used towards calculation as no anomaly was found for any of the days between the flow meter reading and the mass flow calculations.
OH_n Operating hours during project campaign	N/A	Campaign 10: 3 656 Campaign 11: 1 071 Campaign 12: 4 208	The operating hours are determined from the production logs. A trip value for the oxidation temperature of 820°C is applied as the exclusion criterion for determining those hours where the plant was offline during the project campaign.
CL_n Campaign length of project campaign	**FT-76010**	Campaign 10: 109 312 t HNO_3 Campaign 11: 31 445 t HNO_3 Campaign 12: 129 146 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 10: 0.000704 Campaign 11: 0.001001 Campaign 12: 0.001008	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 /11/. Supplier of primary catalyst is W.C. Heraeus.
$GC_{project}$ Gauze composition for the project campaign	N/A	Campaign 10: Platinum (Pt) 55.87% Rhodium (Rh) 3.78% Palladium (Pd) 40.36%	The composition of the gauzes for the current monitoring period was verified report provided by supplier /11/. Type of primary catalyst is Heraeus FTC Plus. The composition used in the baseline campaign (as well as the operation condition campaigns) was verified to be 56.5 % Pt, 3.8% Rh and 39.7 % Pd. The compositions

		Campaign 11: Platinum (Pt) 61.62% Rhodium (Rh) 3.96% Palladium (Pd) 34.42% Campaign 12: Platinum (Pt) 55.88% Rhodium (Rh) 3.78% Palladium (Pd) 40.34%	used in the project campaigns are hence the same type for campaigns 10 and 12 as used in the baseline campaign. However, as the gauze composition for project campaign 11 is different from GC_{normal}, the default baseline emission factor of 4.5 $kgN_2O/tHNO_3$ was used for campaign 11.
OT_h (°C) Oxidation Temperature for each hour	**TE- 76159/1 76159/2 76159/3 76159/4 76159/5**	N/A	The monitoring of OT_h is required by AM0034 in order to determine when the plant was operating outside of OT_{normal} and is only applicable for the baseline campaign, see section 3.7.4. However, during the project campaigns, the parameter is used to determine if the plant is out of operation. Calibration is performed during the plant shutdown between two successive campaigns. Calibration certificates were made available, which confirm that calibration was valid for the whole monitoring period /14/.
OP_h (Pa-gauge) Oxidation Pressure for each hour	**PT-76002-1**	N/A	The monitoring of OP_h is required by AM0034 in order to determine when the plant was operating outside of OP_{normal} and is only applicable for the baseline campaign, see section 3.7.4.
AFR (t NH_3/h) Ammonia gas flow rate to the ammonia oxidation reactor.	**FT-76003/1**	N/A	The monitoring of AFR is required by AM0034 in order to determine when the plant was operating outside of AFR_{max} and is only applicable for the baseline campaign, see section 3.7.4.
AIFR (% v/v) Ammonia to air ratio	N/A	N/A	The monitoring of AIFR is required by AM0034 in order to determine when the plant was operating outside of $AIFR_{max}$ and is only applicable for the baseline campaign,

			see 3.7.4.

3.7.4 Monitored data for baseline emissions within the project boundary

The verification of the baseline campaign data and the determination of the baseline campaign emission factor were included in the scope of the first verification /25/.

Since the length of the project campaign 10 (PC10= 109 312 t 100% HNO_3) is shorter than the normal campaign length (CL_{normal} = 127 302.4 t 100% HNO_3), EF_{BL} was 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 $EF_{BL.}$

Further the length of the project campaign 11 (PC11= 31 445 t 100% HNO_3) is also shorter than the normal campaign length (CL_{normal} = 127 302.4 t 100% HNO_3), however as the gauze composition for project campaign 11 is different from $GC_{normal,}$ the default baseline emission factor of 4.5 $kgN_2O/tHNO_3$ is used for that campaign and no recalculation of EF_{BL} is required for project campaign 11 as per the methodology.

Furthermore, the length of the current project campaign 12 (PC12= 129 146 t 100% HNO_3) is longer than the normal campaign length (CL_{normal} = 127 302.4 t 100% HNO_3), no recalculation of EF_{BL} is required for project campaign 12 as per the methodology. It is confirmed that the calculation of the baseline emission factor was correctly executed following the requirement of the applied methodology AM0034 version 02.

The following equipments and related documentations were assessed as part of the first verification /25/. Further details on each monitoring parameter are given in Appendix C:

Data variable	Tag. No.	Reported value for the baseline calculation	Assessment / Observation
VSG_{BC} Normal gas volume flow rate of the stack gas during baseline	**FT-76550**	72 468 Nm^3/h	See comments in 3.7.3 VSG_{BC} was verified by DNV to be correctly reported /2//25/.
$NCSG_{BC}$ N_2O concentration in the stack gas (mgN_2O/Nm^3)	**AR-76020-2**	1 630.03 mg/m^3 (recalculated for Campaign 10 as 1618.44 mg/m^3)	During the baseline campaign, the concentration of N_2O in the stack gas was continuously measured by the non-dispersive infrared photometry (NDIR) analyser MIR 9000 /25/ (this analyser was replaced by the ABB AO2040 Uras 14 analyser after the baseline campaign). The N_2O concentration was recorded every two seconds and hourly means were derived by the data acquisition system. Sufficient documentation was provided

			for the fulfilment of QAL 1 /6/. According to the QAL 2 report, the combined relative uncertainty of the analyser is 2.68% /5/. The standard reference method (SRM) showed a deviation to the AMS. Correction factor based on TÜV QAL 2 reference measurements was 1.104 /5/. It has been verified that the same value of correction factor is used in the calculation spread sheet for adjusting the N_2O concentration during the baseline campaign. $NCSG_{BC}$ was verified by DNV to be correctly reported /2//25/.
OH_{BC} Operating hours of the plant	N/A	4 950 h	See comments in 3.7.3 OH_{BC} was verified by DNV to be correctly reported /2//25/.
CL_{BL}/NAP_{BC} t HNO3 Nitric acid 100% concentrated produced over a project campaign	**FT-76010**	134 700 $tHNO_3$	See comments in 3.7.3 NAP_{BC} was verified by DNV to be correctly reported /2//25/.
BE_{BC} **(tN_2O)**	**N/A**	651.983 (recalculated for Campaign 10 as 647.350)	BE_{BC} was verified by DNV to be correctly calculated and reported /2//25/.
EF_{BL} Emission factor for baseline period $tN_2O/t\ HNO_3$	N/A	0.004647 $t\ N_2O/\ t\ HNO_3$ (recalculated for Campaign 10 as 0.004614 $t\ N_2O/\ t\ HNO_3$)	EF_{BL} was verified by DNV to be correctly calculated and reported /2//25/.
GS_{BL} Gauze supplier for baseline campaign	N/A	W.C. Heraues	Verified during the first verification /25/.

GC_{BL} Gauze composition for baseline campaign	N/A	56.5 % Pt 3.8% Rh 39.7% Pd	Verified during the first verification /25/. Type of primary catalyst was Heraeus FTC Plus.
OP_h (kPa-gauge) Hourly oxidation pressure during the baseline campaign	**PT-76002-1**	N/A	OP_h is measured to check if the parameter is within the permitted operating range during the baseline campaign or if the plant is out of operation. This was verified during validation of the project /26/. More details are given in Appendix C.
OT_h (°C) Hourly oxidation temperature during the baseline campaign	**TE-76159/1 76159/2 76159/3 76159/4 76159/5**	N/A	OT_h is measured to check if the parameter is within the permitted operating range during the baseline campaign or if the plant is out of operation. This was verified during validation of the project /26/. More details are given in Appendix C.
AFR (t NH_3/h) Ammonia gas flow rate to ammonia oxidation reactor	**FT-76003/1**	N/A	AFR is measured to check if the parameter is within the permitted operating range during the baseline campaign or if the plant is out of operation. This was verified during validation of the project /26/. More details are given in Appendix C.
AIFR (% v/v) Ammonia to Air ratio into ammonia oxidation reactor during baseline campaign	N/A	N/A	AIFR is measured to check if the parameter is within the permitted operating range during the baseline campaign or if the plant is out of operation. This was verified during validation of the project /26/. More details are given in Appendix C.

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.

Data variable	Reported value	Assessment/ Observation
UNC	Campaign PC10: 3.99 % Campaign PC12:	The overall uncertainties for the AMS have been reported in the QAL 2 report /5/. For campaign 11, the default baseline emission factor of 4.5

	3.99 %	$kgN_2O/tHNO_3$ is used, therefore UNC value is not used for this campaign.
$EF_{ma,n}$ Moving average emission factor derived over the time from campaign specific emission factors. $tN_2O/t\ HNO_3$	Campaign PC10: 0.000960 Campaign PC11: 0.000963 Campaign PC12: 0.000967	The moving average is calculated as the average of EF_n from all the campaigns until PC9. $EF_{ma,n} = (EF_1 + EF_2 + \ldots + EF_n) / n$ Refer to the calculation procedure in section 1.4. Calculation of the emission factors for the previous project campaigns is also presented in the excel sheet /2/ from where it was verified that the $EF_{ma,n}$ has been correctly calculated and reported.
EF_{min} The lowest of EFn observed during the first ten campaigns of the project crediting period. $tN_2O/t\ HNO_3$	0.42	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 should use EF_{min} and not EF_n for emission reductions calculation. However, for all three campaigns $EF_n > EF_{min}$.
EF_p Emission factor used for the specific campaign n $tN_2O/t\ HNO_3$	Campaign PC10: 0.000960 Campaign PC11: 0.001001 Campaign PC12: 0.001008	The higher of the two values $EF_{ma,n}$ and EF_n has correctly been applied in the emission reduction calculations /2/.
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. The N_2O regulation is followed up during the project campaigns and included in the monitoring report. Further African Explosives Ltd. has included the ISO 14001 procedure for following up any new environmental regulations /17//18/.
NOx regulation		At the site visit the NOx concentration was observed to be below the value set by the Ministry of Environmental Protection (400 ppm) /17/.

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) /3/. Access to hourly raw data was made available to DNV /2/ in order to check the data presented through the N.DBMS. These data was verified by DNV. Additionally, an excel spreadsheet is provided to determine the campaign mean values from the raw data, and allow cross checking of the results from the database /2/. DNV verified the spreadsheet and no deviations were found with the database.

Measurements are performed by calibrated equipments and calibrations are valid for the entire monitoring period. The key data can also be cross-checked via other sources, such as control room stations and on-site meters. No assumptions are used that have any material influence on reported emission reductions.

The project proponent has provided Excel sheets containing the raw data and ER calculations /2/. The data was verified 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 the applied methodology. In accordance with AM0034 version 2 no leakage calculation is required.

The calculations of the emission reduction in the spreadsheet /2/ and the monitoring report /1/ 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 the correct application of 95% confidence interval; and total N_2O emissions of the project campaign were calculated correctly. Correction factors of 1.01 (for baseline campaign) and 0.96 (for project campaign) were applied for gas flow rate and 1.104 (for baseline campaign) 0.99 (for project campaign) were applied for N_2O concentration. The correction factors were properly applied to the mean NSCG and VSG values.
2) The nitric acid productions (100% HNO_3) for the baseline and project campaigns covered in the monitoring period were calculated correctly. The number of hours of operation in the project campaign covered in the monitoring period was also correctly calculated.
3) The project emission factors were correctly calculated.
4) The baseline emission factor was correctly determined according to AM0034. Where $CL_n < CL_{normal}$, EF_{BL} was correctly recalculated as per the methodology (refer to section 3.7.4 for details)..
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 emissions reductions were correctly calculated with consideration if the HNO_3 design capacity was exceeded in the project campaign.
7) During AMS downtime, results for NCSG and VSG were replaced by maximum value of that campaign.

The overall uncertainty for the AMS has been determined to be 3.99 % /6/. 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 AEL 11 of Africans Explosives Ltd. is ISO9001 and ISO14001 certified /12//13/. A CDM procedure is developed for the project activity and incorporated into the quality assurance system. Audits are performed twice a year.

Local operators, instrumentation engineers and calibration personnel have been trained by equipment suppliers and are 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 of quality control:

- QAL 1: According to CDM-EB48 report, para77, "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 EN ISO14956". DNV was able to verify that, before the installation of AMS, the evaluation has been carried out by a third party laboratory/testing institute with ISO 17025 accreditation and the evaluation is deemed acceptable /6/.
- QAL2: The installed AMS is tested and compared to a SRM.
  - For the N_2O analyzer, the latest QAL2 tests were conducted on 22-25 June 2011 by MÜLLER-BBM /7/. The QAL2 correction factor (0.99) remained unchanged.
  - For stack gas flow measurement, the latest QAL2 tests were carried out by MÜLLER-BBM in July 2010 /7/. A new QAL2 correction factor (changed from 1.010 to 0.96) was defined for stack gas flow in July 2010.
- AST: The latest AST for N_2O analyzer was performed in June 2011 (as part of the QAL2 tests) /7/. In these tests, it was confirmed that operation of the AMS was acceptable and that the calibration functions for NCSG (determined during previous QAL2) was still valid and that the requirements for variability are fulfilled /7/. The AST for VSG was also performed in June 2011. In these tests, it was confirmed that operation of the AMS was acceptable and that the calibration functions for VSG (determined during QAL2) was still valid and that the requirements for variability are fulfilled /7/.
- QAL3: Span and zero checks are carried out twice a week. DNV checked the records on-site and confirmed the frequency /9/.

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 1364"N2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa" in South Africa for the period 18 April 2012 to 05 June 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 PDD (version 1.c. of 25 September 2007) and the monitoring report (version 04) dated 3 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 18 April 2012 to 05 June 2013 are fairly stated in the monitoring report (version 04) dated 3 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 PDD (version 1.c. of 25 September 2007).

DNV Climate Change Services AS is able to certify that the emission reductions from the CDM project activity 1364 "N2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa" in South Africa during the period 18 April 2012 to 31 December 2012 amount to 177 168 tonnes of CO_2 equivalent and the emission reductions during the period 1 January 2013 05 June 2013 amount to 121 560 tonnes of CO_2 equivalent.

Oslo, 3 July 2014

Rafi-ud-Din Khawaja
Verifier
DNV Climate Change Services AS

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 1364 "N2O abatement* project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa*" for the monitoring period 18 April 2012 to 05 June 2013*, Version 01 dated 22 November 2013 and version 04 dated 3 July 2014.

/2/ CDM Project Spreadsheet for the verification period 18 April 2012 to 05 June 2013. Filename:

- *Project 1364 Monitoring period 18_04_2012 - 05_06_2013 Emission reduction calculation.xlsx*
- *Project 1364 Monitoring period 18_04_2012 - 05_06_2013 Emission reduction calculation_V02.xlsx*
- *AEL 11 sample data 04062013.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 QAL2 report. Report no. IS-US3-MUC/th dated 06 September 2007. (QAL2 for MIR 9000 analyser used in the baseline campaign, period of test 01.08.2007 to 04.08.2007). Valid until 2012.*

/6/ - *TÜV SUD QAL 1 report Uras 14 (analyzer used during project campaigns). Report number 2410 6657 and 170 608 dated June 2006*

- *TÛV Rheinland: Report on the laboratory test of the Multigas analyzer MIR 9000 CLD Option of the company Environment S.A (analyzer used during baseline campaign). for the measurement of NO/NOx, NO_2; CO_2; O_2; N_2O and CH_4. (QAL 1)*

/7/

- *TÜV SUD Industrie Services QAL2 report. Report no. IS-US3-MUC/th dated 09 July 2008. QAL2 for Uras 14 analyzer. Period of test 09.02.2008 to 11.02.2008. Valid until 8 February 2013*
- *MÜLLER-BBM report M86 201/2: "Report on performance tests for the component N2O and calibration of the components volume flow, temperature and pressure of continuously operating measuring system on a nitric acid producing plant". AST for N_2O analyzer and QAL2 test for volume flow, temperature and pressure. Conducted on 6 to 8 July 2010, QAL2 valid until 5 July 2015, AST valid until 5 July 2011, date of report 4 November 2010.*
- *MÜLLER-BBM report M92 321/2: "Report on performance tests (AST) and calibration (QAL2) of continuously operating measuring systems on a nitric acid producing plant" for AEL11 (QAL2 and AST for N_2O analyzer and only AST for volume flow, temperature and pressure), dated 30 September 2011, tests on 22 to 25 June 2011, QAL2 valid until 21 June 2016 and AST valid until*

21 June 2012.

- *MÜLLER-BBM report M100097/2: "Report on performance tests (AST) of continuously operating measuring systems on a nitric acid producing plant" for AEL11 (AST for N_2O analyzer and volume flow, temperature and pressure), dated 08 August 2012, tests on 03 to 04 July 2012, QAL2 valid until 21 June 2016 and AST valid until 02 July 2013.*

/8/
- Linde: Certificate of analysis for test gas: Nitrous oxide (N_2O): 1095 ppm, Balance: N_2, Uncertainty: +/-2% (used from 10 October 2011 until 05 February 2013). Certification date 13 July 2011, valid for 24 months. Cylinder No. 310949.
- Linde: Certificate of analysis for test gas: Nitrous oxide (N_2O): 1057 ppm, Balance: N_2, Uncertainty: +/-2% (used from 01 May 2013 until the end of the monitoring period). Certification date 04 February 2013, valid for 24 months. Cylinder No. 312463.

* No span checks were performed for the period 05/02/2013 – 01/05/2013. For the period 02/05/2013 until 05/06/2013 a wrong span gas value of 1000 ppm instead of 1057 ppm was applied during the span gas checks (Refer to Section 3.7.3 for details).

/9/
- QAL3 Calibration reports for N_2O analyser MIR 9000 (used during baseline campaign): AT-76020-2 N_2O Analyzer Calibration Cell Report form July 2006 to February 2007.
- QAL3 Calibration reports for N_2O analyser ABB Uras 14 (used during the project campaigns): AT-76020-2 N_2O Analyzer Calibration Cell Report form 18 April 2012 to 05 June 2013

/10/ African Explosives Ltd.: Daily production reports for the period from 18 April 2012 to 05 June 2013

/11/ W.C. Heraeus : Compositions of Primary Catalyst Gauzes for AEL 11 dated 29 November 2013:
For Campaign 10: Pt: 55.87%, Rh: 3.78%, Pd: 40.36%
For Campaign 11: Pt: 61.62%, Rh: 3.96%, Pd: 34.42%
For Campaign 12: Pt: 55.88%, Rh: 3.78%, Pd: 40.34%

/12/ SABS Commercial Ltd.: ISO 9001:2008 Certificate number LS 243 valid until 08 September 2015 and ISO 9001:2008 Certificate number LS 1052 valid until 19 November 2015

/13/ SABS Commercial Ltd.: ISO 14001:2004 Certificate number EM 140394 valid until ISO 03 February 2015

/14/ Calibration Certificates:
Nitric acid flow meter (NAP) Tag. No. FT-76010:
Dates of calibration relevant to the current monitoring period:
- ALPRET Controls Specialists: Nitric acid flow meter Tag. No. FT-76010. 9 March 2011, valid until 8 March 2014.
-Internal calibration by AEL Ltd.
Stack gas flow meter Tag. No. FT-76550 (VSG/VSG_{BC}), stack gas temperature Tag. No. TE-76170 (TSG), stack gas pressure Tag. No. PT-76506 (PSG):
Dates of internal calibration : 21.04.2012; 09.08.2012; 28.11.2012; and 07.06.2013 (valid until 06.01.2014)

Oxidation temperature (OT_h) Tag. No. TE-76159/1-5:
Dates of internal calibration : 21.04.2012; 06.08.2012; 27.02.2013; and 07.06.2013
Oxidation pressure (OPh) Tag.no. PT-76002-1:
Dates of internal calibration : 21.04.2012; 06.08.2012; 27.02.2013; and 07.06.2013
Ammonia flow rate (AFR) Tag.no. 76003/1:
Dates of internal calibration : 21.04.2012; 06.08.2012; 27.02.2013; and 07.06.2013
Primary air to ammonia oxidation reactor (used to calculate AIFR):
Dates of internal calibration : 21.04.2012; 06.08.2012; 27.02.2013; and 07.06.2013

/15/ 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
- Certificate of Competence of Mr. R. Huggins number 7611285179088 dated 21 July 2008
- Confirmation letter for training of Nomsa Phiri number 663465

/16/ 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.

/17/ Republic of South Africa – Department of Environmental Affairs and Tourism - Atmosphere pollution prevention Act 1965 (Act 45 of 1965).

/18/ 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

/19/ Route Calibration Services: Calibration certificate No. S 110. Dated 31.07.2009 (uncertainty of nitric acid flow meter).

/20/ AEL Ltd: Procedure for Nitric acid production determination, revision 00 dated 13 February 2009

/21/ African Explosives Ltd.: Every 2 second raw data for the end of the project campaign 12
AEL 11 sample data 04062013.slsx

/22/ African Explosives Ltd.: Equipment breakdown report for N_2O analyzer dated 11 December 2013

/23/ Email communication between N.serve and Instrument Technician from African Explosives Ltd dated 18 December 2013

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

/24/ *CDM-PDD for project activity "*N2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa, version 1.c. of 25 September 2007

/25/ DNV Climate Change Services AS: *Verification / Certification report for project activity 1364 "N2O abatement* project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa*:*

- Report no 2010-1012 revision 02 dated 16 December 2011 for the monitoring period 08 February 2008 to 23 May 2009 (1st verification period)
- Report no 2012-0548 revision 01 dated 27 August 2012 for the monitoring period 24 May 2009 – 16 November 2010 (2nd verification period)
- Report no 2012-0293 revision 01 dated 27 August 2012 for the monitoring period 17 November 2010 – 28 February 2011 (3rd verification period)
- Report no 2012-1104 revision 01 dated 5 September 2012 for the monitoring period 1 March 2011 – 6 August 2011 (4th verification period)
- Report no 2012-1235 revision 01 dated 8 October 2012 for the monitoring period 7 August 2011 – 17 April 2012 (5th verification period)\

/26/ Validation report by TÜV SUD: "N_2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa", report no. 1017249, 27 September 2007.

Methodologies, tools and other guidance by the CDM Executive Board

/27/ CDM Executive Board: *Clean Development Mechanism Validation and Verification Standard*, version 05.0

/28/ CDM Executive Board: *Clean Development Mechanism Project Standard,* version 05.0

/29/ CDM Executive Board: *Clean Development Mechanism Project Cycle Procedure,* version 05.0

/30/ CDM Executive Board: *Baseline and monitoring methodology AM0034,* version 02

Persons interviewed during the verification

/31/ Hendrik Burger, Production Manager Nitrates, African Explosives Ltd.

/32/ Thembeka Lucy Dhlodhlo, Production Technical Services Nitrates, African Explosives Ltd.

/33/ Martin Stilkenbaumer, Project manager and Monitoring Expert, N.serve Environmental Services GmbH

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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	The end date of campaign 11 was confirmed to be 26 Nov 2012, while the MR, version 01 mentions 16 Nov 2012 on page 3.	Corrections are made in version 02 of the MR. Further, additional corrections are made on Page 33 of the MR: i.e. the amount of NAP for PC 12 was corrected from 127,440.89 to 129,146.39.	OK. Since the date has been updated in the updated MR version 02 of 07 January 2014. The update in the NAP value is acceptable since it was due to typo in the MR, while the value verified on-site was 129 146.39 $tHNO_3$. CAR 1 is closed.
CAR 2	As verified during the site visit for the short period from 25 September 2012 (17:00) to 28 September 2012 (08:00) flow values used during AMS downtime are not the right values (value used is 76 457 instead of 85 577).	Corrections are done in the updated calculation sheet. New results are incorporated in the MR as well.	OK. The value has been correctly applied in the updated spreadsheet and corresponding edits are made to MR version 02 of 07 January 2014. CAR 2 is closed.
CAR 3	For parameter VSG internal calibration dates prior to 21 April 12 need to be added in the MR in order to cover the entire monitoring period.	Corrections are made in version 02 of the MR.	OK. The date of previous calibration of 10 August 2011 has been added. CAR 3 is closed.

Clarification requests

CL ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CL 1	While checking the real time N_2O data onsite, it was noticed that the N_2O concentration values fluctuated between approximately 120ppm and 190ppm on a 2 second data recording frequency. This fluctuation in concentration needs to be investigated and clarified. Further, it needs to be investigated since when any issues found have been impacting the N_2O values. If needed data collected during the monitoring period need to be corrected. Further related evidences needed to be provided to DNV.	The AMS was checked and sampling system was checked and a filter was found to be blocked and was repaired, 2 second raw data for the end of the project campaign 12 was provided. This data showed normal behavior of N_2O values without abnormal fluctuations. Therefore it could be concluded that the fluctuations occurred after the end of this monitoring period and had no influence on the calculation of emission reductions for this monitoring period. The AEL maintenance report and 2 second raw data is provided to the DOE.	DNV has checked the every 2 second raw data for the end of the project campaign 12 /21/ and agrees with PP that the data shows a normal behavior. DNV also agrees with PP observation that the fluctuation might have occurred due to blocked filter after the end of the monitoring period. (However, FAR 1 will be raised to ensure that the error in data recording is covered in the next monitoring period and also for PP to improve maintenance practices to avoid such events in the future). Further a breakdown report (from AEL) dated 11 December 2013 /22/ and emails dated 18 December 2013 /23/ were reviewed to verify that the issue was due to stuffed filter. CL 1 is closed.
CL 2	The calibration certificate for 7 Jun 2013 is missing for OT_h and needs to be provided.	The calibration certificate is provided.	The calibration certificate has been provided and found OK. CL 2 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	Referring to CL 1 above, this FAR is raised to ensure that the error in data recording is covered in the next monitoring period and also for PP to improve maintenance practices to avoid such events in the future.	PP accepted the FAR by email.*

* Data recording error needs to be considered in the next monitoring period. Further, it needs to be checked that the maintenance practices have been improved to avoid any such errors. FAR 1 is still open.

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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	Not applicable.	☐ Yes ☐ No ☒ Not applicable	*Not applicable*
Changes to the project design of a registered project activity	Not applicable.	☐ Yes ☐ No ☒ Not applicable	*Not applicable*

* No post registration changes have been requested during the current monitoring period.

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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 campaigns
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 – MicroMotion CMF200 TAG: FT-76010
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) is common practice for measuring nitric acid and measurement uncertainty is <=0.1% (as per the supplier) /19/.
Calibration frequency /interval:	Every 3 years. Dates of calibration: 9 March 2011 (valid until 8 March 2014).
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:	Alpret Control Specialists Ltd. /14/
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	Yes /14/
If applicable, has the reported data been cross-checked with other available data?	Yes, the NAP values are also determined from a mass balance method /20/. During this monitoring period only flow meter values were used towards calculation as no anomaly was found for any of the days between the flow meter reading and the mass flow calculations.
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 is automatically transferred in the plant process control system. The daily cumulative value is recorded and printed for archiving. The daily value are transferred to an excel file for analysis and calculation.
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):	**OTh** Oxidation temperature of AOR
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.	Thermocouple type K310S/steel TAG: TE- 76159/1; 76159/2; 76159/3; 76159/4; 76159/5
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. However the measurement uncertainty is 1% (as per AEL calibration requirements)
Calibration frequency /interval:	*Dates of internal calibration :* 21.04.2012; 06.08.2012; 27.02.2013; and 07.06.2013 /14/
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, the frequency represents good monitoring practice.
Company performing the calibration:	AEL internal calibration as per ISO 9001 Procedure no. C09NA revision 1 “Calibration Procedures” of 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 /14/
If applicable, has the reported data been cross-checked with other available data?	N/A
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 is automatically stored in the SCADA Data Acquisition System. Once 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 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?	N/A

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**OPh** Oxidation pressure during the baseline 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:	Yokogawa, type Pressure Tx

Tag.No.	TAG: PT-76002-1
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. However the measurement uncertainty is 1.7% (as per AEL calibration requirements)
Calibration frequency /interval:	*Dates of internal calibration : 21.04.2012; 06.08.2012; 27.02.2013; and 07.06.2013* /14/
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, the frequency represents good monitoring practice.
Company performing the calibration:	AEL internal calibration as per ISO 9001 Procedure no. C09NA revision 1 “Calibration Procedures” of 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 /14/
If applicable, has the reported data been cross-checked with other available data?	N/A
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 is automatically stored in the SCADA Data Acquisition System. Once 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 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?	N/A

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**AIFR** Ammonia to air ratio (determined from the ratio of AFR and primary oxidation air which is the parameter assessed below).
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.	Yokagawa type D.P. transmitter TAG: FT-76002/1
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. However the measurement uncertainty is 1.66% (as per AEL calibration requirements)
Calibration frequency /interval:	*Dates of internal calibration : 21.04.2012; 06.08.2012; 27.02.2013; and 07.06.2013* /14/
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, the frequency represents good monitoring practice.
Company performing the calibration:	AEL internal calibration as per ISO 9001 Procedure no. C09NA revision 1 “Calibration Procedures” of 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

If applicable, has the reported data been cross-checked with other available data?	N/A
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 is automatically stored in the SCADA Data Acquisition System. Once 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 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?	N/A

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**AFR** Ammonia gas flow rate to ammonia oxidation reactor
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.	Yokogawa D.P. Transmitter TAG: FT-76003/1

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. However the measurement uncertainty is 1.25 % (as per AEL calibration requirements)
Calibration frequency /interval:	*Dates of internal calibration : 21.04.2012; 06.08.2012; 27.02.2013; and 07.06.2013* /14/
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, the frequency represents good monitoring practice.
Company performing the calibration:	AEL internal calibration as per ISO 9001 Procedure no. C09NA revision 1 “Calibration Procedures” of 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 /14/
If applicable, has the reported data been cross-checked with other available data?	N/A
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 is automatically stored in the SCADA Data Acquisition System. Once 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 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	N/A

has a request for deviation been approved?	

	Assessment/Observation
Data / Parameter: (as in monitoring plan of PDD):	**NCSG** N_2O concentration in the stack gas
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.	MIR 9000 (baseline campaign) and ABB AO2040 Uras 14 (project campaigns). TAG no. AT-76020-2
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 represents good monitoring practice. The uncertainty of the analyser is 2.68 % and 2.69% for MIR 9000 and ABB AO2040 Uras respectively /5/ /6/ /7/.
Calibration frequency /interval:	**Internal calibration**: By AEL Ltd.: Bi-weekly: Zero and span check and calibration in case of deviation > 1% of range of analyzer. **External calibration:** QAL2 every 5 years and AST every year in between QAL 2 test. **QAL2 tests:** • QAL2 test by TÜV SUD Industrie Services on 9-10 June 2008 /7/, valid until 8 February 2013 • QAL2 tests by Müller-BBM GmbH on 22-25 June 2011 /7/, valid until 21 June 2016.

	AST tests: • Müller-BBM GmbH (as part of the QAL2 test) on 22-25 June 2011 /7/, valid until 21 June 2012. • Müller-BBM GmbH AST (for N_2O analyzer and volume flow, temperature and pressure) on 03-04 July 2012 /7/, valid until 02 July 2013.
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. The calibration is carried out in accordance with EN14181 /17/.
Company performing the calibration:	TÜV SUD Industrie Services and MÜLLER-BBM /5//7/ Internal calibration by AEL Ltd. /9/. QAL2/AST is performed by external company accredited for ISO 17025 /16/.
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 21 June 2016 and AST is valid until 02 July 2013 /7/. The zero and span checks were performed bi-weekly as specified in AEL internal procedure /9/.
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 system.
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 is automatically stored in the SCADA Data Acquisition System. Once 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 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 22 June 2012 (1 year after the last AST). However, AST tests were done from 03 - 04 July 2012 /7/. As per para 238 of VVS /27/ the maximum permissible error of the instruments for VCSG was applied for the period from 22 June 2012 to 02 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/. No span checks were performed for the period 05 February 2013 – 01 May 2013 /8/. As per para 238 of VVS /27/ the maximum permissible error of the instruments for VCSG was applied for the period from 05 February 2013 – 01 May 2013 /2/. Further, for the period 02 May 2013 until 05 June 2013 a wrong span gas value of 1000 ppm instead of 1057 ppm was applied during the span gas checks. Respective corrections were also applied to the monitoring data for this period /2/

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**TSG**
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: Rosemont Model 644 RAI TAG. TE-76170

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?	Yes. Measurement uncertainty: 2.55% (as per QAL 2 test report) /7/
Calibration frequency /interval:	**Internal calibration**: Internal calibration at least once per year usually every 7 months after each campaign /14/. Meter is calibrated as per ISO 9001 Procedure no C09NA revision 1 “Calibration Procedures” of African Explosives Ltd. **External calibration:** QAL2 every 5 years and AST every year in between QAL 2 test. **QAL2 tests:** • QAL2 tests by Müller-BBM GmbH on 22-25 June 2011 /7/, valid until 21 June 2016. **AST tests:** Müller-BBM GmbH on 03-04 July 2012 /7/, valid until 02 July 2013.
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. QAL2/AST test is performed in accordance with EN 14181 /7/.
Company performing the calibration:	TÜV SUD Industrie Services and MÜLLER-BBM /7/ Internal calibration by AEL Ltd. /14/.
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 21 June 2016 and AST is valid until 02 July 2013 /7/. Internal calibrations are also valid for the whole monitoring period.
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 system.
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 is automatically stored in the SCADA Data Acquisition System. Once 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 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 22 June 2012 (1 year after the last AST). However, AST tests were done from 03 - 04 July 2012 /7/. As per para 238 of VVS /27/ the maximum permissible error of the instruments for VCSG was applied for the period from 22 June 2012 to 02 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/.

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**PSG**
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.	Rosemont pressure probe. Transmitter: Rosemount; type 3051TA1A2B21BB4I1M5Q4 TAG. PT-76506

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?	Yes. Measurement uncertainty: 0.7% (as per QAL2 report) /7/.
Calibration frequency /interval:	**Internal calibration**: Internal calibration at least once per year usually every 7 months after each campaign /14/. Meter is calibrated as per ISO 9001 Procedure no C09NA revision 1 "Calibration Procedures" of African Explosives Ltd. **External calibration:** QAL2 every 5 years and AST every year in between QAL 2 test. **QAL2 tests:** • QAL2 tests by Müller-BBM GmbH on 22-25 June 2011 /7/, valid until 21 June 2016. **AST tests:** Müller-BBM GmbH on 03-04 July 2012 /7/, valid until 02 July 2013.
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. QAL2/AST test is performed in accordance with EN14181 /7/.
Company performing the calibration:	TÜV SUD Industrie Services and MÜLLER-BBM /7/ Internal calibration by AEL Ltd. /14/.
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 21 June 2016 and AST is valid until 02 July 2013 /7/. Internal calibrations are also valid for the whole monitoring period.
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 system.
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 is automatically stored in the SCADA Data Acquisition System. Once 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 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 22 June 2012 (1 year after the last AST). However, AST tests were done from 03 - 04 July 2012 /7/. As per para 238 of VVS /27/ the maximum permissible error of the instruments for VCSG was applied for the period from 22 June 2012 to 02 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/.

	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 transmitter TAG no. FT-76550

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 analyser is widely used to measure volume flow. Uncertainty is determined in QAL 2 to be ± 2.96 % /7/
Calibration frequency /interval:	**Internal calibration**: Internal calibration at least once per year usually every 7 months after each campaign /14/. Meter is calibrated as per ISO 9001 Procedure no C09NA revision 1 “Calibration Procedures” of African Explosives Ltd. **External calibration:** QAL2 every 5 years and AST every year in between QAL 2 test. **QAL2 tests:** • QAL2 test by TÜV SUD Industrie Services on 9-10 June 2008 /7/, valid until 8 February 2013 • QAL2 tests by Müller-BBM GmbH on 22-25 June 2011 /7/, valid until 21 June 2016. **AST tests:** • Müller-BBM GmbH (as part of the QAL2 test) on 22-25 June 2011 /7/, valid until 21 June 2012. • Müller-BBM GmbH AST (for N_2O analyzer and volume flow, temperature and pressure) on 03-04 July 2012 /7/, valid until 02 July 2013.
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. The calibration is carried out as per EN14181/7/.
Company performing the calibration:	TÜV SUD Industrie Services and MÜLLER-BBM /7/ Internal calibration by AEL Ltd. /14/.
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 21 June 2016 and AST is valid until 02 July 2013 /7/. Internal calibrations are valid for the

	whole monitoring period /14/.
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 system.
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 is automatically stored in the SCADA Data Acquisition System. Once a month the results is downloaded from SCADA to an excel file for analysis and calculation. The raw data is saved on a DAT device and 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 22 June 2012 (1 year after the last AST). However, AST tests were done from 03 - 04 July 2012 /7/. As per para 238 of VVS /27/ the maximum permissible error of the instruments for VCSG was applied for the period from 22 June 2012 to 02 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/.

APPENDIX D

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

Mr. 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 eight years. Prior to joining DNV has around twenty three years of experience in Chemical process industry (fertilizer & petrochemical manufacturing) in the areas of production, technical services, energy audits and efficiency studies, waste heat recovery, efficiency studies of boilers, power plants, safety audits, pollution control activities and waste water treatment. Also conducted various studies in captive thermal power plant such as optimization of flue gas stack temperatures, excess air, efffiacy of fuel additives, condition of boiler refractory and insulation of steam lines, residual life assessment of boilers and generators etc.

While working in technical services department of the Fertilizers & Chemicals Travancore Ltd (FACT), was involved in optimizing the energy consumption of the chemical complex, from conducting feasibility studies, preparing the project design documents, procurement, coordinating the installation and commissioning. Some of the projects implemented are: optimization of instrument air system, installation of variable speed drives for electric motors, retrofit of cooling towers to reduce the cooling water temperature, installation of steam turbines to utilize the surplus steam, installation of burner management system in fertilizer dryer 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.

Undergone the training program on Life Cycle Assessment (LCA) tool of SemaPro, Sustainability Assessment and Lead auditor training in ISO4001. Part of the team in Sustainability assessment of WIPRO in the year 2013.

He is a GHG verfier under ISO 14064 systems. Part of the team in verification of the carbon foot print of Royal Challengers Bangalore in 2013.

He has six years of experience in validation and verification of CDM and VCS projects in DNV and is a Technical Reviewer for these services . 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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