VERIFICATION / CERTIFICATION REPORT

PROJECT FOR THE CATALYTIC REDUCTION OF N_2O EMISSIONS WITH A SECONDARY CATALYST INSIDE THE AMMONIA REACTOR OF THE NO. 9 NITRIC ACID PLANT AT AFRICAN EXPLOSIVES LTD ("AEL"), SOUTH AFRICA

UNFCCC Registration No. 1171

Monitoring Period
16 April 2011 to 14 July 2011

REPORT NO. 2012-1137
REVISION NO. 01

DET NORSKE VERITAS

VERIFICATION / CERTIFICATION REPORT

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Client: African Explosives Ltd	Client ref.: Hendrik Burger

Summary:

DNV Climate Change Services AS has been contracted by African Explosives Ltd to carry out verification and certification of the emission reductions reported for the "Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa" (UNFCCC Ref. No. 1171) for the period 16 April 2011 to 14 July 2011.

In our opinion, the reported N_2O emission reductions for the period from 16 April 2011 to 14 July 2011, as reported in the revised monitoring report for the project version 04 dated 3 september 2012 are fairly stated. The published monitoring report version 01 of 20 October 2011 was updated in order to reflect the issues raised during this verification.

The emission reductions were calculated correctly on the basis of the approved monitoring methodology AM0034 version 02 and the monitoring plan contained in the registered project design document of 5 April 2007.

Hence, DNV Climate Change Services AS is able to certify that the emission reductions from the project during the period 16 April 2011 to 14 July 2011, amount to 32 412 tonnes of CO_2 equivalents.

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Report title: Project for the catalytic reduction of N2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa		
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Abbreviations

AEL	African Explosives Ltd.
AMS	Automated Measuring System
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CER	Certified Emission Reduction(s)
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DNV	Det Norske Veritas
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
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
UNFCCC	United Nations Framework Convention for Climate Change
SRM	Standard Reference Method

1 INTRODUCTION

African Explosives Ltd (hereafter AEL) has commissioned DNV Climate Change Services AS (DNV) to carry out the verification and certification of the emission reductions reported for the "Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa" (hereafter the project) for the period 16 April 2011 to 14 July 2011. This report contains the findings from the verification assignment and a certification statement for the certified emission reductions.

1.1 Objective

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

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

The objective of this verification was to verify and certify emission reductions reported for the "Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa" for the period 16 April 2011 to 14 July 2011.

1.2 Scope

The verification scope is:

- To verify that actual monitoring systems and the procedures are in compliance with the monitoring systems and procedures described in the monitoring plan.
- To evaluate the GHG emission reduction data and express a conclusion with a reasonable level of assurance about whether the reported GHG emission reduction data is free from material misstatement.
- To verify that the reported GHG emission data is sufficiently supported by evidence

The verification shall ensure that the reported emission reductions are complete and that sufficient evidence is provided in order to give reasonable assurance that the amount of calculated GHG emission reductions is fairly stated.

The verification team has based the verification on the recommendations in the Validation and Verification Manual /29/.

1.3 Description of the project activity

Project Parties:	*South Africa, United Kingdom of Great Britain and Northern Ireland and Switzerland*
Titles of project activity:	*Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9*

	nitric acid plant at African Explosives Ltd ("AEL"), South Africa
UNFCCC Registration no.:	*1171*
Baseline and monitoring methodology:	*AM0034(version 02)*
Project Participants:	*African Explosives Ltd ("AEL") and N.serve Environmental Services GmbH ("N.serve")*
Location of the project activity:	*Modderfontein, Province of Gauteng, South Africa*
Registration:	*5 November 2007*
Project's crediting period:	*5 November 2007 to 4 November 2017 (Fixed)*
Period verified in this verification:	*16 April 2011 to 14 July 2011*

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%.

The emission reductions reported from the project for the period from 16 April 2011 to 14 July 2011 amount to 32 412 tonnes of CO_2 equivalents.

1.4 Methodology for determining emission reductions

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 (NAP) for the project campaign ($tHNO_3$) shall not exceed the design capacity of the plant.

The baseline emission factor is determined ex-ante, and may necessarily be recalculated when the length of a project campaign is less 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, 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 2, 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 value 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 of $EF_{ma,n}$ and EF_n) – see below
GWP_{N2O}	Global warming potential of N_2O = 310

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 will be 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 at the stack in the baseline measurement period (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 estimates 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)
PEn	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:

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

To calculate the total emission reductions achieved in a campaign, the higher of the two values $EF_{ma,n}$ and EF_n is applied as the emission factor relevant for the particular campaign to be used to calculate emissions reductions (EF_p) in equation given for ER above. 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 shall be used to cap any potential long-term trend towards decreasing N_2O emissions that may result from a potential built up of platinum deposits. After the first ten campaigns of the crediting period of the project, the lowest EF_n observed during those campaigns will be adopted as a minimum (EF_{min}). If any of the later project campaigns results in an EF_n that is lower than EF_{min}, the calculation of the emission reductions for that particular campaign shall use EF_{min} and not EF_n. Further, EF_{reg} is to be monitored to check if the host party introduces 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

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) /7/ 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)	Salem	Fahad	Norway	✓	✓	✓	✓		✓
Assessor under training	Massicard	Patrice	Norway	✓	✓	✓			
Technical reviewer	Lin	Wu	China					✓	✓

Duration of verification

Monitoring report publication: *24 October 2011*

Preparations: *25 October 2011 to 7 November 2011*

On-site verification: *8 November 2011*

Reporting, calculation checks and QA/QC*:* *8 November 2011 to* 17 September 2012

2.1 Review of Documentation

The basis for the verification has been the monitoring report from the project for the period 16 April 2011 to 14 July 2011 version 01 of 20 October 2011 (published for global stakeholders consultation) and the revised monitoring report version 04 dated 3 september 2012 /1/, the registered project design document (PDD) /2/, and the approved baseline and monitoring methodology applied by the project, AM0034, version 02 /29/. The project operator has 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, /3/ and /5/ -/27/.

2.2 Site Visit

During the site visit of 8 November 2011 at African Explosives Ltd, the following personnel from the project participants were interviewed or assisted the verification team /30/-/32/:

Name	*Organization*	*Position*
Hendrik Burger	African Explosives Ltd	Production Manager Nitrates
Thembeka Lucy Dhlodhlo	African Explosives Ltd	Production Technical Services Nitrates
Martin Stilkenbaumer	N.serve Environmental Services GmbH	Project manager Monitoring Expert

During the site visit, DNV applied standard auditing techniques to assess the quality of information provided. The following aspects of the CDM project activity were confirmed:

- The implementation and operation of the CDM project activity;
- The information flow for generating, aggregating and reporting of the monitoring parameters; and
- The operational and data collection procedures and their implementation in accordance with the monitoring plan.

Further, the following activities were performed:

- For randomly chosen days during the monitoring period, a cross-check was made between information provided in the monitoring report and data from other sources such as plant log books, back-up electronic data storage, 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 the PDD and AM0034 version 02
- 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, 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 /29/ and the management system were assessed during the site visit.

2.3 Reporting of Findings

Findings established during the verification may be that:

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

i. Non-conformities with the monitoring plan or methodology are found in monitoring and reporting, or if the evidence provided to prove conformity is insufficient;
ii. Mistakes have been made in applying assumptions, data or calculations of emission reductions which will impair the estimate of emission reductions;
iii. 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 verification period.

Two CARs, four CLs and one FAR were raised during this verification. Please refer to Appendix A of this report for further details. All the CARs and CLs raised were sufficiently addressed by the project proponent and closed by DNV. The FAR will be assessed during the next verification.

3 VERIFICATION FINDINGS

This section summarises the findings from the verification of the emission reductions reported for the "Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa" for the period 16 April 2011 to 14 July 2011.

3.1 Remaining Issues, CARs, FARs from Previous Verification

One FAR was remaining from the previous verification of the project /22/:

- Evidence supporting the composition of gauzes reported in AEL spreadsheet should be maintained and provided for future verifications.

During site visit, the composition of gauzes for the current and previous campaigns was confirmed by document from the gauze suppliers /27/. Therefore, the FAR is closed.

3.2 Project Implementation

As per para 198 (a) of VVM version 01.2 /28/, DNV verified that the project is fully implemented in accordance with the PDD version 2.0 of 5 April 2007 /2/. Furthermore, as per para 198 (b) of VVM version 01.2, DNV confirmed during the on-site visit that the CDM project is completely operational. Neither a notification nor approval of change has been requested to CDM Executive Board.

All physical features (technology, project equipment and monitoring/metering equipment) of the project are in place as per the registered PDD. The verification team inspected all the field installation and instrumentation necessary for the monitoring of the emission reductions.

The baseline campaign was operated from 5 September 2007 to 6 November 2007. As confirmed in the validation report /4/, the data from the baseline campaign were not verified by the validating DOE, and the confirmation of the baseline campaign data to be used for expost emission reduction calculations was included in the scope of the verifying DOE. Thus the baseline campaign was verified by DNV during the first verification period simultaneously with first project's campaigns /22/. The project was registered on 5 November 2007, which is also the start date of the crediting period. The first project campaign with secondary catalyst installed was started on 9 November 2007. This monitoring period is from 16 April 2011 to 14 July 2011 and comprises one project campaign as stated below.

Campaign PC10 20 April 2011 to 14 July 2011

An overview of the plant shutdowns during this campaign is presented below:

- From 24 April 2011 10:00 to 29 April 2011 23:00

DNV verified the plant shut down periods and special events provided in the monitoring report /1/ by checking the raw data, ER calculations /3/ and the daily production records for these periods. It was verified by DNV that the above periods (relevant hours) are not considered in the overall emission reduction calculations. Furthermore, DNV verified these events by checking the trend curves for the operation and it was confirmed that no further events had occurred during the monitoring period, which require recalculations or exclusion of additional hours in the

calculation of emissions reductions. DNV can confirm there was no AMS downtime or malfunction during the verification period which would require correction to the measured data as per AM0034 requirements.

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

The emission reductions in this monitoring period are 32 412 tonnes of CO_2 equivalents in the period from 16 April 2011 to 14 July 2011 (i.e. 90 days). The yearly expected emission reductions according to the registered PDD are 116 779 tonnes of CO_2 equivalents. This corresponds to emission reductions of 28 795 tonnes of CO_2 equivalents in 90 days and hence the observed emission reductions are higher than the expected. The main reason for the higher than expected CERs is the higher production than anticipated in the PDD (although lower than the design capacity ref. section 3.6.3):
Actual nitric acid production in the monitoring period: 24 172 $tHNO_3$
Average annual nitric acid production used for CER estimates in the PDD: 69 629 $tHNO_3$/year, correspond to 17 169 $tHNO_3$ for a period of 90 days.

Other factors that affect the emission reduction includes the baseline emission factor for the project campaign (0.00564 $tN_2O/tHNO_3$), which is lower than the estimated value that was given in the registered PDD (0.00601 $tN_2O/tHNO_3$), and thus contributing to lower baseline emissions.

The effective abatement efficiency (based on EF_n) during the project campaign PC10 is 92.2%, with is higher than anticipated in the PDD (90%). However the abatement efficiency is only 77% when $EF_{p,}$ is considered, which is the emission factor used towards emission reduction calculation, (ref. section 3.6.5), and contributes to higher project emissions.
The lower baseline emission and higher project emissions partly compensate the higher NAP, and explain the slightly higher emission reductions than the estimated value for this monitoring period.

Therefore, DNV considers that the amount of emission reduction achieved in this monitoring period is reasonable.

3.4 Compliance of monitoring plan with monitoring methodology

DNV is able to confirm that the monitoring plan contained in the registered PDD “Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd (“AEL”), South Africa”, version 2.0 of 5 April 2007 /2/ is in accordance with the approved methodology applied by the project activity, i.e. AM0034 (version 02). Neither a revision nor a deviation to the monitoring plan has been requested to CDM Executive Board.

3.5 Compliance of monitoring with the monitoring plan

DNV is able to confirm that the monitoring is complete and has been carried out in accordance with the monitoring plan contained in the registered PDD “Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd (“AEL”), South Africa”, version 2.0 of 5 April 2007. The

determination of the permitted operating ranges (verified by the validating DOE), the baseline emission factor (verified by DNV during the 1^{st} verification /22/), and the determination of the project emissions are verified and found to be in compliance with AM0034 version 02.

All parameters stated in the validated monitoring plan, the applied methodology AM0034 version 02 and relevant EB decisions have been sufficiently monitored and updated as applicable, including: project emission parameters; baseline emission parameters; leakage parameters; 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. 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 QAL 2 tests have been provided. The QAL 2 tests are performed as per EN14181 and confirm the determination of the overall uncertainty used in the calculation of the baseline emission factor.

3.6 Assessment of Monitoring Parameters

3.6.1 Historical data and permitted operating conditions

In order to avoid that the operation of the nitric acid production plant is manipulated in a way to increase the N_2O generation, and thereby increasing the CERs, the ammonia flow, ammonia to air ratio, operating temperature and pressure in the ammonia oxidation reactor and the use of ammonia oxidation catalyst is monitored during one campaign length (baseline campaign) and compared to the historical values as determined in the PDD. The baseline N_2O emission factor ($tN_2O/tHNO_3$) is determined from the measurements of N_2O concentration and stack gas flow during the baseline campaign prior to the installation of the secondary catalyst. If the plant operates outside of the permitted range for more than 50% of the duration of this baseline, the emission factor is not valid and the baseline campaign needs to be repeated.

In order to take into account the variations in campaign length and its influence on N_2O emission levels, the historic campaign lengths and the baseline campaign length are to be determined and compared to the project campaign length. Campaign length is defined as the total number of metric tonnes of nitric acid at 100% concentration produced with one set of gauzes.

The average historic campaign length (CL_{normal}) defined as the average campaign length for the historic campaigns used to define operating condition, will be used as a cap on the length of the baseline campaign.

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 during a calendar year.

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

The CDM Executive Board clarified in EB31 meeting that either validating or verifying DOE could undertake the task of determination of the permitted operating conditions for project activities using approved methodology AM0034. For this project the determination of the permitted ranges, normal gauze supplier and composition were included in the scope of the validating DOE /4/. However it was stated in the validation report that the verification of normal campaign length should be confirmed by the verifying DOE.

Data variable	**Reported value**	**Observation**
Design capacity	106 621 100% metric tonnes per year based on 365 days of operation (correspond to 292.112 metric tonnes per operating day).	Verified by validating DOE /4/
$\mathbf{OT_{normal}}$	810°C to 915°C	Verified by validating DOE /4/
$\mathbf{OP_{normal}}$	860 to 910 kPa (gauge)	Verified by validating DOE /4/
$\mathbf{AFR_{max}}$	3.877 t NH_3/h	Verified by validating DOE /4/
$\mathbf{AIFR_{max}}$	11.5%	Verified by validating DOE /4/
$\mathbf{CL_{normal}}$ t HNO_3	24 026.2 tonnes	Verified during first verification /22/.
$\mathbf{GS_{normal}}$ Gauze supplier for the operation condition campaigns	W.C. Heraeus	Verified by validating DOE /4/
$\mathbf{GC_{normal}}$ Gauze composition for the operation condition campaigns	Platium (Pt) 59% Rhodium (Rh) 4% Palladium (Pd) 37%	Verified by validating DOE /4/

3.6.2 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 /2/ as per the applied and approved methodology, AM0034 version 02 /29/.

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

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

- Stack gas flow rate and standardisation 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 available in the network system as digital values. Each of the two nitric acid plants at AEL 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) /7/.

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.

At N.serve the received data is stored at 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 is responsible for the correct data handling and processing.
The nitric acid production is measured by mass flow meter and the data are automatically transferred to the plant's control system. Daily cumulative data are stored and printed for archiving.
In order to verify the correct data is used DNV has checked data from productions logs and raw data taken from the SCADA system and compared these against the data and calculations 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 3.6.3 to 3.6.6 below. Further detailed information on recording frequency and calibration are given in Appendix B.

3.6.3 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 can only be requested for the nitric acid production up to the design capacity. For the AEL9 plant, the design capacity is 106 621 tons of 100% HNO_3 per year (based on 365 days of operation and 292.112 t per day) /2/.

The production during the monitoring period (90 days) is 24 172 tons of 100% HNO_3. The corresponding production at design capacity is 26 290 tHNO_3 (292.112 t per day x 90 days). The production during this monitoring period is therefore below the design capacity for the plant.

The following equipment and related documentation has been assessed, refer to Annex B for further details and information about calibration of the monitoring equipment:

Data variable	Tag. No.	Reported value Campaign PC10	Assessment /Observation
VSG Normal gas volume flow rate of the stack gas during project campaign (Nm^3/h)	**FT-200**	42 032 Nm^3/h Range: 18-45 000 Nm^3/h	The stack gas flow rate is continuously measured with a flow meter: Emerson Rosemount Annubar Model 485 combined with pressure transmitter Rosemount 3051S Static pressure and process temperature are measured with a single pipe penetration, and compensated flow is calculated dynamically (Nm^3/h). All transmitters were properly installed. Specification of the flow meter is provided /5/. The flow meter was calibrated prior to shipment by the supplier Emerson Rosemount and thereafter regularly in accordance with AEL calibration routine /19/. The measurement range of the flow meter is appropriate and the measured average flow rate is within the range expected for the nitric acid plant. First QAL2 test was conducted on 7 to 13 February 2008 /6/, valid until 6 February 2013. The last AST was performed on 6 July 2010 /10/ and new QAL2 test was conducted on 21-24 June 2011 /10/. As a result from the last QAL2, the correction factor of 1.02 is to be applied on VSG measurements (changed from

			0.96 from previous QAL 2 /6/). Conservatively, the correction factor of 1.02 has been applied to VSG data for the entire monitoring period, which was verified from the calculation spreadsheets /3/. DNV confirms that the instrument calibration is valid for the whole monitoring period. Additionally internal calibrations were conducted and records /19/ were also verified by DNV.
TSG (°C)	**TE–120**	Range: 0-500 °C The temperature is used for standardisation of volume flow rate in the stack.	The temperature in the stack gas is measured by a thermocouple type PT100_385 3-wire RTD Transmitter: Rosemount Model 644 RAI. First QAL2 test was conducted by TÜV SUD on 7 to 13 February 2008 /6/, valid until 6 February 2013. The last AST was performed on 6 July 2010 /10/ and new QAL2 test was conducted by MÜLLER-BBM on 21-24 June 2011 /10/. DNV confirms that the instrument calibration is valid for the whole monitoring period. Additionally internal calibrations were conducted and records /19/ were also verified by DNV
PSG (hPa abs)	**PT-200**	Range 0 – 1000 hPa (abs). The pressure is used for standardisation of volume flow rate in the stack	The pressure in the stack gas is measured by a Rosemount pressure probe. Transmitter: Rosemount; type 3051TA1A2B21BB4I1M5Q4. First QAL2 test was conducted by TÜV SUD on 7 to 13 February 2008 /6/, valid until 6 February 2013. The last AST was performed on 6 July 2010 /10/ and new QAL2 test was conducted by MÜLLER-BBM on 21-24 June 2011 /10/. DNV confirms that the instrument calibration is valid for the whole monitoring period. Additionally internal calibrations were conducted and records /19/ were verified by DNV.
NCSG N_2O concentration in the stack	**AT-110**	135.73 mg /Nm^3	The concentration of N_2O in the stack gas is continuously measured by the non-dispersive infrared photometry (NDIR) analyser ABB AO2040-Uras14. The N_2O concentration is recorded every two

gas (mgN_2O/Nm^3 converted from ppmv)		Range: 0-2000 ppmv	seconds and hourly means are derived by the data acquisition system. Sufficient documentation has been provided for the fulfilment of QAL 1 /8/ /9/. First QAL2 test was conducted by TÜV SUD on 07 to 13 February 2008 /6/, valid until 6 February 2013. The last AST was performed on 6 July 2010 /10/ and new QAL2 test was conducted by MÜLLER-BBM on 21-24 June 2011 /10/. As a result from the last QAL2, the correction factor of 0.97 is to be applied on NCSG measurements (unchanged from previous QAL 2 /6/). It was verified on the calculation spreadsheets /3/ that this value has been applied to NCSG data for the monitoring period. DNV confirms that the instrument calibration is valid for the whole monitoring period. Additionally internal calibration was conducted and records /19/ were verified by DNV. Zero and span checks (QAL3) were done regularly during the project campaign by trained AEL personnel /19/. It was observed that the QAL3 were done weekly or every 2 weeks instead of twice a week as specified in AEL internal procedure. It should be noted that span check frequency was recommended as one every 3 weeks in QAL1 /9/, thus AEL internal procedure represents better monitoring practice than strictly required. Since the results of the zero and span check were all within allowable deviation of 1%, no adjustement of analyser was necessary and the longer interval between QAL3 has no impact on the correct operation of the analyser. It was clarified that the change in calibration interval was due to a change of personnel, and regular interval (twice in week) will be restored in future (ref. FAR1). The calibration gas used for span check was 1021 ppmv during the project campaigns, with a precision of ± 2% /11/. The analyser room and equipment is inspected weekly.
NAP $tHNO_3$ Nitric acid 100%	**FT-111**	**24 172** t HNO_3	The nitric acid is measured with a mass flow meter Coriolis Micro Motion CMF 200 from Emerson. 100% nitric acid is calculated from the measurements of flow from the mass flow

concentrated produced over a project campaign			meter, and the concentration. The concentration is measured as an integral part of the flow meter. The concentration is checked against manual measurement of concentration in laboratory. Calibration certificates are provided /19/. Equipment specification was provided at the site visit. The flow accuracy is <= 0.1 % of measured flow rate. Sampling of concentration measurements and values from mass flow meter were performed during the site visit including checks of transfer of data. An analysis was provided to DNV showing 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 appropriate. A clarification (CL1) was also raised by DNV in this regard which was closed after receiving an appropriate response from the PP.
OH Operating hours during project campaign (hours)	N/A	**1 896**	Operating hours are determined from the production data /3/. A trip value for the oxidation temperature of 810°C is applied as the exclusion criterion for determining those hours where the plant was offline during the project campaign (during shut down OT_h is reported at 800.6 degC, while all other parameters are at zero. Thus, the trip value of 810 is used by the plant and temperatures below this value are representative of shut down situation. OH was verified by DNV to be correctly reported /3/.
CL_n Campaign length of project campaign ($tHNO_3$)	**FT-111**	**24 172**	The CL_n has the same value as reported for NAP above. The monitoring equipment is as described for NAP.
EF_n Emission factor for project campaign n	N/A	**0.00044**	The value has been calculated from monitoring data using the algorithm described in N.DBMS /7/ which is as per the methodology. The calculations are exported to an excel file /3/. The spread sheet calculations have been

$tN_2O/tHNO_3$			checked and found to be correct. Hourly raw data was made available for verification.
$GS_{project}$ Gauze supplier for the project campaign	N/A	**W.C. Heraeus**	At the site visit invoices were made available for verification of the catalyst supplier /14/.
$GC_{project}$ Gauze composition for the project campaign	N/A	**Platium (Pt) 60.2% Rhodium (Rh) 3.9% Palladium (Pd) 35.9%**	The composition used in the project campaign PC10 was verified from the receipts from the catalyst supplier available for verification /14/. DNV confirms that the composition without significant difference from that used in the baseline and historical campaigns.
OT_h (°C) Oxidation Temperature for each hour	**TC-102-A TC-102-B TC-102-C TC-102-D**	**N/A**	The monitoring of OT_h is required by AM0034 in order to determine when the plant was operating outside of OT_{normal} during the baseline campaign (see section 3.6.4). The parameter is also used to check if the plant is in operation (if the temperature is below 810°C, the plant is considered to be shut down). This criterion is then used to calculate the operating hours (OH) of the plant. Calibration is performed in between each campaign in accordance to the procedure "C9NA 002 Nitrates calibration procedure". Calibration certificates were checked and DNV is able to confirm the calibration result is OK. Calibration were performed November 2010 and July 2011, however no calibration was done before the start of campaign PC10 (April 2011) /19/ It was clarified that this delay in calibration has no impact on the emission reduction calculation (ref. CL3).
OP_h (Pa-gauge) Oxidation Pressure for each hour	**PT-100**	**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 3.6.4.
AFR (t NH_3/h) Ammonia gas flow rate to the ammonia oxidation	**FT101**	**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 3.6.4.

reactor.			
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 3.6.4.

3.6.4 Monitored data for baseline emissions within the project boundary

The verification of the baseline campaign data (campaign H15, from 5 September 2007 to 6 November 2007) and the determination of the baseline campaign emission factor were included in the scope of the verifying DOE /4/. As per the methodology, if the length of each individual project campaign CL_n is longer than or equal to the average historic campaign length CL_{normal} then all N_2O values measured during the baseline campaign can be used for the calculation of EF_{BL} (subject to the elimination of data from the operating limits analysis). However, if $CL_n < CL_{normal}$, EF_{BL} is recalculated by eliminating those N_2O values that were obtained during the production of tonnes of nitric acid beyond the CL_{BL} (i.e. the last tonnes produced) from the calculation of EF_{BL}.

The length of project campaign PC10 (24 172t 100% HNO_3) is longer than the average historical campaign length, CL_{normal} (24 026.2 t 100% HNO_3), therefore, the regular baseline emission factor EF_{BL} of 0.00564 $tN_2O/tHNO_3$ verified during the first verification /22/ is applied without recalculation. Information and details about calibration of the monitoring equipment used during baseline determination are given in Appendix B.

Data variable	Tag. No.	Value applicable for PC9	Assessment / Observation
VSG_{BC} Normal gas volume flow rate of the stack gas during baseline	**FT-200**	42 983 Nm^3/h	See comments in 3.6.3 VSG_{BC} was verified by DNV to be correctly reported /22/. The measurement range of the flow meter is appropriate and the measured average flow rate is within the range expected for a nitric acid plant with a capacity of 292.112 metric tonnes per day. The calibration is performed as per the monitoring plan in the registered PDD and is documented /18/. DNV can confirm the correction factor determined in QAL 2 /6/ for VSG was retroactively and correctly applied to the data for VSG monitored during the baseline campaign /24/.

$NCSG_{BC}$ N_2O concentration in the stack gas (mgN_2O/Nm^3 converted from ppm)	**AT-110**	1 764.44 mg/Nm^3	See comments in 3.6.3 $NCSG_{BC}$ for PC10 is calculated correctly /22/. The calibration is performed as per the monitoring plan in the registered PDD and is documented /6/. DNV can confirm the correction factor determined in QAL 2 for NCSG /6/ was retroactively and correctly applied to the data for NCSG value monitored during the baseline campaign /24/.
OH_{BC} Operating hours of the plant	N/A	1 474 h	See comments in 3.6.3. OH_{BC} was verified by DNV to be correctly reported /22/.
NAP_{BC} t HNO3 Nitric acid 100% concentrated produced over a project campaign	**FT-111**	17 718 t/HNO_3	See comments in 3.6.3. NAP_{BC} was verified by DNV to be correctly reported /18/
EF_{BL} Emission factor for baseline period $tN_2O/t\ HNO_3$	N/A	0.00564 $t\ N_2O/\ t\ HNO_3$	EF_{BL} was verified by DNV to be correctly calculated and reported according to EB 51 Annex 12 /3/.
AFR Ammonia gas flow rate to the AOR	**FT101**	Available in excel sheets /3/	AFR is continuously monitored. $NCSG_{BL}$ and VSG_{BL} values monitored when AFR is exceeding AFR_{max} are excluded prior to the calculation of the average values for $NCSG_{BL}$ and VSG_{BL} /3/. Calibration is performed in accordance to the procedure "C9NA 002 Nitrates calibration procedure". Calibration certificates were checked and DNV is able to confirm the calibration result is OK. The calibration is valid for the entire period for the baseline campaign /18/.

AIFR Ammonia to Air Ration	**FT-100** (air flow) **FT-101** (NH_3 flow)	Available in excel sheets /3/	AIFR is calculated from results of AFR (Tag No.: FT101) and Primary Air flow rate (Tag No.: FT100). $NCSG_{BL}$ and VSG_{BL} values monitored when AIFR is exceeding $AIFR_{max}$ are excluded prior to the calculation of the average values for $NCSG_{BL}$ and VSG_{BL} /3/ Calibration is performed in accordance to the procedure "C9NA 002 Nitrates calibration procedure". Calibration certificates were checked and DNV is able to confirm the calibration result is OK. The calibration is valid for the entire period for the baseline campaign /18/.
OT_h Oxidation temperature for each hour	**TC102-A** **TC102-B** **TC102-C** **TC102-D**	Available in excel sheets /3/	OT_h is monitored hourly. $NCSG_{BL}$ and VSG_{BL} values monitored when OT_h is outside the permitted operating range are excluded prior to the calculation of the average values for $NCSG_{BL}$ and VSG_{BL} /3/. Calibration is performed in accordance to the procedure "C9NA 002 Nitrates calibration procedure". Calibration certificates were checked and DNV is able to confirm the calibration result is OK. The calibration is valid the entire period for the baseline campaign /18/.
OP_h Oxidation Pressure for each hour	**PT-100**	Available in excel sheets /3/	OP_h is monitored hourly. $NCSG_{BL}$ and VSG_{BL} values monitored when OP_h is outside the permitted operating range are excluded prior to the calculation of the average values for $NCSG_{BL}$ and VSG_{BL} /3/. Calibration is performed in accordance to the procedure "C9NA 002 Nitrates calibration procedure". Calibration certificates were checked and DNV is able to confirm the calibration result is OK. The calibration is valid the entire period for the baseline campaign /18/.
GS_{BL} Gauze supplier for baseline campaign	N/A	W.C. Heraues	Verified by validating DOE /4/.

GC_{BL} Gauze composition for baseline campaign	N/A	59% Pt 4% Rh 37% Pd	Verified by validating DOE /4/.

3.6.5 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 use of raw data. Other data for the required parameter according to AM0034 and the source of data was checked.

Data variable	**Reported value**	**Assessment/ Observation**
UNC	**4.2 %**	The overall uncertainties for the AMS have been reported in the QAL 2 report /6/.
$EF_{ma,n}$ Moving average emission factor derived over the time from campaign specific emission factors. $tN_2O/t\ HNO_3$	**0.00131**	The moving average is calculated as the average of EF_n from all the previous campaigns (including the campaign n in this monitoring period) as: $EF_{ma,n} = (EF_1 + EF_2 + \ldots + EF_n) / n$ ($tN_2O/tHNO_3$) DNV has verified the emission factors' data for previous campaigns /22/ and confirms that $EF_{ma,n}$ has been correctly calculated.
EF_{min} The lowest of EFn observed during the first ten campaigns of the project crediting period. $tN_2O/t\ HNO_3$	**0.00027**	Since the campaign included in this monitoring period is counted as the 10^{th} project campaign, EF_{min} can be determined. This parameter will be applied from the next campaign onwards, in case $EF_n < EF_{min}$.

EF_p Emmision factor used for the specific campaign n $tN_2O/t\ HNO_3$	**0.00131**	As required by the methodology AM0034 version 02, the higher of the two values of $EF_{ma,n}$ and EF_n has correctly been applied in the emission reduction calculations.
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 /21/. This parameter is reported in the monitoring report in E.1:"Data and parameters for calculation of Baseline campaign emissions". The N_2O regulation is followed up during the project campaigns and included in the monitoring report. Further African Explosives Ltd has included procedure for following up any new regulations in its ISO 14001 systems /16/.
NO_x regulation	**-**	At the site visit, the NO_x concentration was observed to be below the regulation limit of 400 ppm set by the Ministry of Environmental Protection /21/.

3.6.6 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.

3.7 Quality of Evidence to Determine Emission Reductions

The main monitoring parameters are automatically collected by the monitoring system. The raw data are stored as 2 second values at two different locations. All necessary documentation is collected, referenced and aggregated and is easily accessible in spread sheets generated by N.DBMS (N.serve Database Management System). Access to hourly raw data was made available to DNV /3/ in order to check the data presented through the N.DBMS. In order to cross check the results of the database, a third excel spreadsheet is provided (Project 1171 Monitoring period 05_ 16_04_2011 - 14_07_2011 Emission reduction calculation.xlsx) /3/, which includes the determination of the mean values from the raw data as well as emission reduction calculations. DNV verified the calculations and no deviation was found compared with the results of the database.

Measurements are performed by calibrated equipment /6/ /10/ /19/ and calibrations are valid both for the baseline campaign and the current monitoring period. The key data has also been cross-checked via other sources, such as control room stations and on-site meters. There was no incident resulting in AMS downtime during the monitoring period. No assumptions are used, that have any influence on reported emission reductions.

The project participants have provided excel sheets containing the raw data and calculations for the campaign no. PC10 /3/. These datasheets were verified by DNV and DNV confirms the calculations of baseline emissions and project emissions have been carried out in accordance with the formulae and methods described in the monitoring plan and applied methodology. As per the methodology, AM0034 version 2, no leakage calculation is required.

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

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

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

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

3.8 Management System and Quality Assurance

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

The nitric acid plant AEL9 of African Explosives Ltd. is ISO9001 and ISO14001 certified /15/ /16/. A CDM procedure is developed for the project activity and incorporated into the quality assurance system /13/. Internal audits are performed twice a year.

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

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

- QAL1: According to CDM-EB48 report, para 77, "for project activities where the automated monitoring system (AMS) for the measurement of N_2O is subject to compliance with EN14181 as stipulated in the applied methodologies, the Board further clarified that the suitability test QAL1 for the AMS by any entity is acceptable provided that a documentary evidence is submitted which confirms the measures and method conducted are in accordance with the provisions specified in ISO14956". DNV was able to verify that the evaluation has been carried out by TÛV SUD before installation of

AMS according to ISO14956 version 1.0, and the evaluation is deemed to be acceptable.[1] /8/ /9/.

- QAL2: The installed AMS is tested and compared to a SRM. QAL2 test was carried out by TÜV SUD Industrie Services on 7 to 13 February 2008 (date of report 19 March 2008) /6/; and new QAL2 test (including AST) was conducted on 21 to 24 June 2011 by MÜLLER-BBM, valid until June 2016 /10/.
- DNV can confirm the correction factors determined in QAL 2 was correctly applied to the data for NCSG and VSG monitored during the project campaign. Further the maximum uncertainty of the AMS (UNC) was correctly applied to the calculation of the baseline emissions factor as per the methodology.
- AST: The latest annuals surveillance test (AST) was performed on 6 July 2010 and confirmed that operation of the AMS was acceptable and that the calibration functions for NCSG and VSG were still valid and that the requirements for variability are fulfilled /10/.
- QAL3: Span and zero checks are carried out regularly throughout the monitoring period /19/, however it was observed that the QAL3 were done weekly or every 2 weeks instead of twice as week as specified in AEL internal procedure. Since the results of the zero and span check were all within allowable the deviation of 1%, no adjustement of analyser was necessary and the longer interval between QAL3 has no impact on the correct operation of the analyser. It was clarified that the regular interval (twice in week) will be restored in future (ref. FAR1).

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

4 CERTIFICATION STATEMENT

DNV Climate Change Services AS (DNV) has performed the verification of the emission reductions that have been reported for the project "Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa" (UNFCCC Registration Reference No.1171) for the period 16 April 2011 to 14 July 2011.

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.

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

DNV conducted the verification on the basis of the monitoring methodology AM0034 (version 02), the monitoring plan contained in the registered Project Design Document version 2.0 of 5 April 2007 and the monitoring report version 04 dated 3 september 2012. 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 of the "Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa" (UNFCCC Registration Ref. No.1171) for the period 16 April 2011 to 14 July 2011 are fairly stated in the monitoring report version 04 dated 3 september 2012.

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 registered PDD version 2.0 of 5 April 2007.

DNV Climate Change Services AS is able to certify that the emission reductions from the "Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa" during the period 16 April 2011 to 14 July 2011 amount to 32 412 tonnes of CO_2 equivalents.

Oslo, 17 September 2012

Fahad Salem
CDM Verifier
DNV Climate Change Services AS

Trine Kopperud
Head of Approval Centre & Nordic
DNV Climate Change Services AS

5 REFERENCES

Documents provided by the Project Participants that relate directly to the GHG components of the project. These have been used as direct sources of evidence for the periodic verification conclusions, and are usually further checked through interviews with key personnel.

/1/ CDM Monitoring Report: "Project for the catalytic reduction of N_2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa" (No 5), version 01 of 20 October 2011 and version 04 dated 3 september 2012.

/2/ CDM Project Design Document: "Project for the catalytic reduction of N2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa", Version 2.0, date of completion: 05 April 2007.

/3/ CDM Project Spreadsheets for the verification period 16 April 2011 to 14 July 2011
Excel file for reporting raw data:
- CDM Data No.9 5th MP.xlsx

Excel file for reporting calculation of emission reductions from database:
- AEL_No9_MP5_PC_Calc_V3_MS_20120729.xlsx

Excel file for calculation of emission reduction from raw data:
- Project 1171 Monitoring period 05_ 16_04_2011 - 14_07_2011 Emission reduction calculation.xlsx

/4/ Validation report by TÜV SUD: "Project for the catalytic reduction of N2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa", report no. 912444, 10 May 2007.

/5/ Product specification for stack gas flow meter:
The Annubar Flowmeter Series. Product Data Sheet 00813-0100-4809, Rev GA
Of November 2008.

/6/ TÜV SUD Industrie Services QAL 2 report. Author Erhard Krämer. Report no. IS-US3-MUC dated 19 March 2008 (Test conducted from 07.02.2008 to 13.02.2008).

/7/ Martin Stilkenbäumer, N.serve: Documentation of N.serve Database Management System for N_2O Destruction CDM Projects.

/8/ TÜV SÜD Suitability test report for German Standards, March 2003.

/9/ TÜV SUD QAL 1 report Uras 26 (follow-up version of Uras 14), June 2006.

/10/ MÜLLER-BBM report M80 456/1: "Report on performance test of continuously operating measuring system on a nitric acid plant". (AST) dated 27 July 2009 (Test conducted from 10.06.2009 to 11.06.2009).
MÜLLER-BBM report M92 321/1: "Report on performance tests of continuously operating measuring systems on a nitric acid producing plant, Nitrates No.9". AST conducted on 6 July 2010, valid until 5 July 2011, date of report 26 October 2010.
MÜLLER-BBM report M92 321/1"Report on performance test (AST) and calibration (QAL2) of continuously operating measuring systems on a nitric acid plant, Nitrates No.9", dated 21 September 2011 (tests conducted 21-24 June 2011).

/11/ Afrox Ltd.: Certificates of analysis of calibration test gases during the monitoring period. .

Cylinder No 1152853. Analysis report dated 17 March 2010 (1021ppm), stability 2 years.

/12/ Calibration reports N_2O analyser ABB AO2040 Uras 14:

- AT-110 N_2O Analyzer Calibration Cell Report from September 2007 (baseline campaign).

/13/ African Explosives Ltd. “Procedure for CDM data preparation” revision 00 of 13.02.2008.

/14/ Heraeus South Africa Ltd. Ammonia Oxidation Catalyst, AEL No.9 Campaigns Confirmation for PC10.

/15/ ISO 9001:2008 Certificate number LS 0243 issued by SABS Commercial Ltd. valid until 8 September 2012.

/16/ ISO 14001:2004 Certificate number EM 140394 issued by SABS Commercial Ltd. valid until 3 February 2012.

/17/ Instrument data sheets:

-Nitric acid flow meter Tag. No. FT-111.

-Stack gas flow meter Tag.No. FT-200

-N_2O analyser Tag. No. AT-110

/18/ African Explosives Ltd.: Calibration certificates for the baseline campaign

Calibration certificates for stack gas parameters by AEL Ltd:

VSG - tail gas flow (FT-200):

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

NCSG - N_2O concentration in the stack gas (AT-110): see reference /12/

TSG – Tail gas temperature (TE-120):

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

PSG- Tail gas pressure (PT-200):

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

Nitric acid flow meter (FT-111):

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

Calibration certificates for AOR parameters equipment by AEL Ltd:

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

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

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

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

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

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

OPh – Oxidation pressure (PT-100):

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

/19/ Calibration Certificates relevant for the current monitoring period:

VSG - tail gas flow (FT-200):

- Calibration dates: 10 February 2011, and 15 June 2011. Validity of calibration: 4 months (calibration is done at the end of each campaign)

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

- QAL3 tests done weekly or every 2 weeks from the period 16 April 2011 to 14 July 2011

TSG – Tail gas temperature (TE-120):

- Calibration dates: 10 February 2011 and 15 June 2011. Validity of calibration: 1 year (calibration is done at the end of each campaign)

PSG- Tail gas pressure (PT-200):

- Calibration dates: 10 February 2011 and 15 June 2011. Validity of calibration: 1 year (calibration is done at the end of each campaign)

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

- ALPRET Controls Specialists: Nitric acid flow meter Tag. No. FT-111. Date 24 November 2010 Valid for 3 years until 23 November 2013.

Calibration certificates for AOR parameters equipment by AEL Ltd (Calibration is done only during the plant shut down between two campaign)**:**

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

Calibration dates: 4 November 2010 and 22 July 2011. Valid until 21 January 2012

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

Calibration dates: 4 November 2010 and 22 July 2011. Valid until 21 January 2012

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

Calibration dates: 4 November 2010, 25 July 2011. Valid until 24 January 2012

OPh – Oxidation pressure (PT-100):

Calibration dates: , 4 November 2010 and 22 July 2011. Valid until 21 January 2012

/20/ 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

/21/ Republic of South Africa – Department of Environmental Affairs and Tourism - Atmosphere pollution prevention Act 1965 of December 2003.

/22/ DNV Climate Change Services AS: Verification reports for the project activity “Project

for the catalytic reduction of N2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL"), South Africa":

Report no. 2010-0900 version 02 dated 30 May 2012, monitoring period 5 November 2007 to 10 February 2008

Report no. 2010-9065, version 03 dated 20 June 2012, monitoring period 11 February 2008 to 04 August 2009

Report no 2011-1256 version 01 dated 30 August 2012, monitoring period 5 August 2009 to 1 July 2010

Report no 2012-0986 version 01 dated 29 August 2012, monitoring period 2 July 2010 to 15 April 2011

/23/ Route Calibration Services: Calibration certificate No. S 110. Dated 31.07.2009 (uncertainty of nitric acid flow meter).

/24/ CDM Project Spreadsheets for the verification period 05 November 2007 to 10 February 2010, including baseline campaign data:

AEL 9_PC_No1_Calc_V8b_MS_100708.xls

/25/ Historical NAP data:

No9 NAP per campaign_CLnormal_MS_20110321.xls

/26/ AEL Ltd: Procedure for Nitric acid production determination, revision 00 dated 13 February 2009.

/27/ Heraeus South Africa Ltd: composition of primary gauze.

Background documents related to the design and/or methodologies employed in the design or other reference documents.

/28/ CDM Executive Board: Validation and Verification Manual. Version 01.2

/29/ CDM Executive Board, Approved Monitoring methodology AM0034, version 02

Persons interviewed during the initial verification, or persons who contributed with other information that are not included in the documents listed above.

/30/ Hendrik Burger, Production Manager Nitrates, African Explosives Ltd.

/31/ Thembeka Lucy Dhlodhlo, Production Technical Services Nitrates, African Explosives Ltd.

/32/ Martin Stilkenbaumer, Monitoring expert, N.serve

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APPENDIX A

CORRECTIVE ACTION REQUESTS, CLARIFICATION REQUESTS AND FORWARD ACTION REQUEST

Corrective action requests

CAR ID	Corrective action request	Response by Project Participants	DNV's assessment of response by Project Participants
CAR 1	A correction factor of 1.0 is applied for VSG in the CER calculation. However the correction factor was reported to be 0.96 in the previous QAL2 conducted in 2008 and 1.02 from the new QAL2 test performed from 21 June 2011 to 24 June 2011. The CER calculation needs to be corrected based on the latest QAL2 factor.	The CER calculation was updated and the new QAL 2 factor of 1.02 for VSG was conservatively applied for the complete campaign.	DNV verified the revised calculation spreadsheet /3/ and confirmed that the correction factor of 1.02 was correctly applied to the VSG data for the complete campaign. Therefore, the CAR is closed.
CAR 2	The internal calibration dates for VSG, NAP, TSG, PSG should be corrected in the monitoring report. The calibration of OT_h, OP_h, AFR and AIFR should also be included in the monitoring report.	The calibration dates for VSG, NAP, TSG and PSG were updated in the monitoring report. The calibration dates for the operational parameters were also included in the monitoring report.	The internal calibration dates have been correctly updated in the monitoring report. Calibration information for operational parameters, although not required for project campaign, has also been included. Therefore, the CAR is closed.

Clarification requests

CL ID	Clarification request	Response by Project Participants	DNV's assessment of response by Project Participants
CL 1	It was clarified that the NAP measurement from the flowmeter is cross-checked by a mass balance calculation. When a difference of +/- 10% is observed, the reading from the flowmeter is substituted by a value calculated from ammonia consumption, assuming 100% conversion efficiency. During the current monitoring period, substitute value has been applied on 9 May 2011 even though the cross-check with mass balance results in a difference of less than 10%. This substitution needs to be clarified.	For 9 May 2011 the difference between the mass balance and the flow meter readings was less than 10%. Never the less the flow meter reading of that day was compared to the calculated value and the calculated value was better reflecting the operational parameters of the plant. Therefore the calculated value (based on ammonia consumption) was used.	The explanation for replacement of NAP value on 9 May 2011 is reasonable and DNV confirms that the replaced NAP value is appropriate. Therefore, the CL is closed.
CL 2	The calibration certificate of the gas bottle from AFROX (in use during the current monitoring period) needs to be provided.	The calibration certificate for the N_2O span gas cylinder was provided to DNV.	Relevant Calibration certificate for calibration gas has been provided and verified by DNV. Therefore, the CL is closed.

CL 3	Calibration dates for OT_h, OP_h and AFR were verified to be 4 November 2010 and 25 July 11. However the calibration certificate validity is 4 month, and calibration is normally done between each campaign. Calibration certificate at the beginning of the campaign is missing and need to be provided.	No additional calibration between 04/11/2010 and 25/07/2011 had occurred for OTh and no additional calibrations between 04/11/2010 and 22/07/2011 had occurred for OPh, AFR and AIFR although they should have been performed according to the AEL internal procedures. Since according to the approved methodology AM0034, the operational parameters OTh, OPh, AFR and AIFR are only used for evaluation of the Baseline campaign and not for the project campaign, this delay of calibration has no impact on the results of this monitoring period.	It is noted that no calibration was conducted for the operational parameters between November 2010 until July 2011, although it should be performed in between in each campaign (about 4 month). Nevertheless, the monitoring of these parameters is only required by the methodology for the baseline campaign, thus the delay in calibration has no impact for this monitoring period. Therefore, the CL is closed.
CL 4	It was observed during raw data checking that the back-up data stored in the DCS are different from the raw data stored in the SCADA PCs, while the raw data used for CDM calculations are the same as the data stored on the SCADA PCs. Please clarify why the data stored in the DCS are different than the raw data in the SCADA PCs.	The original data is stored in the SCADA PC system. These values corresponded to the values that were used for the CER calculation. The second copy in the DCS system is not used for the purposes of the CDM project. The case was investigated and the reason for the small deviations in one of the files of the DCS systems could not be finally clarified. Several spotchecks on other files were made and no other differences between the DCS files and the files on the SCADA PC were identified. Since the files from the DCS system are not used for the project calculation, this has no impact on the results for this monitoring period.	It is noted that no explanation is found for the difference in raw data between SCADA PC and DCS files. The SCADA PC is the primary source for recording and archiving raw data, and also used for ER calculations. Data stored in DCS are additional copy of raw, which is not directly used for ER calculations. As both set of data were found similar up to now, and the difference observed in this period has no impact on result of this verification, the CL is closed.

Forward action requests from previous verification

FAR ID	Forward action request	Summary of how FAR has been addressed in this reporting period	Assessment of how FAR has been addressed
FAR 1	Evidence supporting the composition of gauzes reported in AEL spreadsheet should be maintained and provided for future verifications.	The confirmation regarding gauze composition was obtained from the supplier and was presented during the verification audit.	Composition of primary gauze was provided by the supplier /29/ and verified by DNV during site visit. Therefore, the FAR is closed.

Forward action requests from this verification

FAR ID	Forward action request	Response by Project Participants
FAR 1	It is stated in the registered monitoring plan that zero calibration and span check (QAL3) would be performed biweekly. During the monitoring period though, the zero and span check were performed biweekly until 21/04/2011, then weekly or every 2 weeks. It was clarified during the audit that it corresponds to a change of the responsible person doing this calibration. Action should be taken to ensure that biweekly QAL3 calibration will be done during the next campaign, or update internal calibration procedure if necessary. It was also observed that the concentration of the calibrated gas bottle installed on 10 October 2011 (outside the current monitoring period) is 1 080 ppm, while the span check considered the nominal concentration of 1 000 ppm for reporting purposes. This need to be corrected by the next verification audit.	According to the QAL 1 reports and manufacturers specifications it is recommended to perform a zero/span calibration once every three weeks for the ABB AO2040 URAS 14 NDIR analyser, however AEL decided to do it twice per week in order to have a closer control over the instrument. The new person in charge was informed about the internal procedure and a weekly routine for checking the calibration log files was established. The concentration of the certified gas cylinder installed on 10/10/2011 is 1080 ppm, while the span check considered the nominal concentration of 1000 ppm for reporting purposes. A correction factor of 1.08 was applied to all NCSG values from 10/10/2011 to 21/11/2011 (the period when the analyzer was calibrated with the wrong span gas concentration value of 1000 ppm instead of 1080 ppm).

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APPENDIX B

VERIFICATION MONITORING PARAMETERS

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**NAP** Nitric acid 100% concentrated produced over a baseline campaign/project campaign
Measuring frequency:	Continuously
Reporting frequency:	Every Hour
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag.No.	Mass Flow Meter – Micro Motion CMF200 TAG: FT-111
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the monitoring is not stated in the PDD. The monitoring equipment (Coriolis mass flow meter) is common practice for measuring nitric acid and measurement uncertainty is 0.1% (as per the supplier).
Calibration frequency /interval:	Every three years
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.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	Yes /18/ /19/
If applicable, has the reported data been cross-checked with other available data?	The data has been cross checked with NAP data from mass balance method /26/.
How were the values in the monitoring report verified?	DNV performed samples checks of production log books
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK, all activities are regulated by QA/QC Procedures. The data are automatically transferred and stored in the plant’s process control system. All data necessary for the emission reduction calculation are manually transferred to the dedicated relational database management system (N.DBMS) and excel

	calculations spreadsheets. DNV checked the raw data from the PCS and no error was found.
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	NA

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**NCSG** N_2O concentration in the stack gas
Measuring frequency:	Continuously
Reporting frequency:	Every 2 seconds
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag.No.	ABB AO2040 Uras 14 TAG no AT-110
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the N_2O analyser was not stated in the PDD as the installed analyser at the time of validation was a S.A. MIR 9000 analyser. However it was stated in the PDD that a new analyser ABB AO2040 Uras 14 will be installed in May 2007. The installed analyzer ABB AO2040 Uras 14 is widely used to measure N_2O concentration and have also passed QAL 1. The ABB AO2040 Uras 14 was used during the baseline and project campaign. The measurement accuracy is determined to be 2.69% (as per QAL 2 report) /6/
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: QAL 2 by an authorized ISO 17025 institute every 5 years, AST test every year in between QAL 2 test /6/

	/10/.
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?	Analyzer is calibrated as per ISO 9001 Procedure no C09NA revision 1 “Calibration Procedures” of African Explosives Ltd.
Company performing the calibration:	External calibration : QAL2 Report number IS-US3-MUC issued by TÜV SUD Industrie Services on date 19 March 2008 (tests on 7-13 February 2008) /6/. New QAL 2 test were performed on 21-24 June 2011 by MÜLLER-BBM Gmbh /10/. AST test: Müller-BBM Gmbh on 10-11 June 2009, report dated 27 July 2009 and on 6 July 2010, report dated 26 October 2010 /10/. Internal calibration by AEL Nitrates Instrumentation Department: Zero and span was done by AEL every 2 weeks.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes /6/ /18/ /19/
Is(are) calibration(s) valid for the whole reporting period?	The zero and span checks were performed every week or 2 weeks instead of bi-weekly as specified in AEL internal procedure. However DNV has checked that this delay in calibration has no impact on ER calculations (ref. section 3.6.3 and FAR1).
If applicable, has the reported data been cross-checked with other available data?	The data are cross-checked with the concentration measurement by a SRM during the QAL 2 test /6/.
How were the values in the monitoring report verified?	Raw data from the monitoring period were provided and checked by DNV /3/. Random picked data points were checked against data stored on the monitoring PC.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK, all activities are regulated by QA/QC Procedures. The data are automatically stored in the SCADA Data Acquisition System. Once a month the results will be downloaded from SCADA to an excel file for analysis and calculation. The raw data will be saved on a DAT device and will be stored in

	a strongbox in the IT office. All data necessary for the emission reduction calculation are digitally transferred from the Plant data system (SCADA) to the dedicated relational database management system (N.DBMS).
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	NA

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**TSG** (stack gas temperature)
Measuring frequency:	Every 2 seconds
Reporting frequency:	Hourly average
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag.No.	Thermocouple type PT100_385-3 wire RTD Transmitter: Rosemount Model 644 RAI Tag. No.: TE-120
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The monitoring equipment represents good monitoring practice. Measurement uncertainty: 2.55% (as per QAL 2 test report) /6/
Calibration frequency /interval:	Internal calibration at least once per year, usually every 4 months after each campaign /18/ /19/. QAL 2 test every 5 years, and AST test every year in between QAL 2 test.
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	Meter is calibrated as per ISO 9001 Procedure no C09NA revision 1 “Calibration Procedures” of African Explosives Ltd

represent good monitoring practise?	
Company performing the calibration:	Internal calibration by AEL Nitrates Instrumentation Department /18/ /19/. QAL 2 tests were performed on 7-13 February 2008 by TÜV SUD Industrie Services /6/ and on 21-24 June 2011 by MÜLLER-BBM Gmbh/10/. AST test: Müller-BBM Gmbh on 10-11 June 2009, report dated 27 July 2009 and on 6 July 2010, report dated 26 October 2010 /10/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	Yes. The latest QAL 2 test is valid until June 2016 /10/, and next AST should be done by 20th June 2012.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Raw data from the monitoring period were provided and checked by DNV. Random picked data points were checked against data stored on the monitoring PC.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK. All activities are regulated by QA/QC Procedures. The data are automatically stored in the SCADA Data Acquisition System. One a month the results will be downloaded from SCADA to an excel file for analysis and calculation. The raw data will be saved on a DAT device and will be stored in a strongbox in the IT office. All data necessary for the emission reduction calculation are digitally transferred from the Plant data system (SCADA) to the dedicated relational database management system (N.DBMS).

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

	Assessment/ Observation
Data / Parameter: (as in monitoring plan of PDD):	**PSG** (stack gas pressure)
Measuring frequency:	Every 2 seconds
Reporting frequency:	Hourly average
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag No.	Rosemount pressure probe. Transmitter: Rosemount; type 3051TA1A2B21BB4I1M5Q4 Tag no.: PT-200
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The monitoring equipment represents good monitoring practice. Measurement uncertainty: 0.7% (as per QAL 2 report) /6/.
Calibration frequency /interval:	Internal calibration at least once per year, usually every 4 months after each campaign /18/ /19/. QAL 2 test every 5 year, and AST test every year in between QAL2 test /6/ /10/.
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 QAL 2 test is performed in accordance with EN14181 /6/
Company performing the calibration:	Internal calibration by AEL Nitrates Instrumentation Department /18/ /19/. QAL 2 tests were performed on 7-13 February 2008 by TÜV SUD Industrie Services /6/ and on 21-24 June 2011 by MÜLLER-BBM Gmbh/10/.

	AST test: Müller-BBM Gmbh on 10-11 June 2009, report dated 27 July 2009 and on 6 July2010, report dated 26 October 2010 /10/.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Yes
Is(are) calibration(s) valid for the whole reporting period?	Yes, the last QAL 2 test is valid until June 2016, and next AST should be done by 20th June 2012.
If applicable, has the reported data been cross-checked with other available data?	NA
How were the values in the monitoring report verified?	Raw data from the monitoring period were provided and checked by DNV. Random picked data points were checked against data stored on the monitoring PC.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK. All activities are regulated by QA/QC Procedures. The data are automatically stored in the SCADA Data Acquisition System. One a month the results will be downloaded from SCADA to an excel file for analysis and calculation. The raw data will be saved on a DAT device and will be stored in a strongbox in the IT office. All data necessary for the emission reduction calculation are digitally transferred from the Plant data system (SCADA) to the dedicated relational database management system (N.DBMS).
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	NA

	Assessment/ Observation

Data / Parameter: (as in monitoring plan of PDD):	**VSG** Stack gas flow
Measuring frequency:	Every 2 seconds
Reporting frequency:	Hourly average
Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag No.	Emerson Rosemount Annubar Model 485 with 3051S pressure transmitter TAG no FT-200
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the flow meter was not stated in the PDD. This analyzer is widely used to measure volume flow. Uncertainty is determined in QAL 2 to be ± 2.65 %.
Calibration frequency /interval:	Internal calibration at least once per year usually every 4 months after each campaign /18/ /19/. QAL 2 test every 5 years /6/, and AST test every year in between QAL 2 test /10/.
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?	Internal calibration: Meter is calibrated as per ISO 9001 Procedure no C09NA revision 1 “Calibration Procedures” of African Explosives Ltd QAL2 Report number IS-US3-MUC issued by TÜV SUD Industrie Services on date 19 March 2008 (tests on 7-13 February 2008) /6/. New QAL 2 test were performed on 21-24 June 2011 by MÜLLER-BBM Gmbh/10/. AST test: Müller-BBM Gmbh on 10-11 June 2009, report dated 27 July 2009 and on 6 July 2010, report dated 26 October 2010 /10/.
Company performing the calibration:	Initial QAL2 Report issued by TÜV SUD Industrie Services /6/. QAL 2 report. Author Erhard Krämer. AST test and new QAL2 by Müller-BBM Gmbh /10/.

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?	NA
How were the values in the monitoring report verified?	Raw data from the monitoring period were provided and checked by DNV /3/. Random picked data points were checked against data stored on the monitoring PC.
Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK. All activities are regulated by QA/QC Procedures. The data are automatically stored in the SCADA Data Acquisition System. One a month the results will be downloaded from SCADA to an excel file for analysis and calculation. The raw data will be saved on a DAT device and will be stored in a strongbox in the IT office. All data necessary for the emission reduction calculation are digitally transferred from the Plant data system (SCADA) to the dedicated relational database management system (N.DBMS).
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	NA

	Assessment/ Observation
Data / Parameters: (as in monitoring plan of PDD):	**OT_h, OP_h, AFR and AIFR** (AIFR is calculated from results of AFR (Tag No.: FT101) and Primary Air flow rate (Tag No.: FT100))
Measuring frequency:	Continously
Reporting frequency:	Hourly average

Is measuring and reporting frequency in accordance with the monitoring plan and monitoring methodology? (Yes / No)	Yes
Type of monitoring equipment: Tag No.	Thermocouples AOR: Type K-6 Multipoint thermocouple Tag. No.: TC-102-A, TC-102-B, TC-102-C, TC-102-D Pressure AOR: PT-100, Yokogawa type Press Tx Ammonia flowmeter: FT101, Yokogawa type orifice plate with D.P. transmitter Primary Air flow rate: FT100, Yokogawa D.P. transmitter.
Is accuracy of the monitoring equipment as stated in the PDD? If the PDD does not specify the accuracy of the monitoring equipment, does the monitoring equipment represent good monitoring practise?	The accuracy of the monitoring is not stated in the PDD. The measurement accuracy is 1% for thermocouples, 1.7% for oxidation pressure, 1.25% for AFR and 1.66% for AIFR (air flow) as per calibration requirements at AEL. The monitoring equipment represent good monitoring practice.
Calibration frequency /interval:	Between 2 campaigns
Is the calibration interval in line with the monitoring plan of the PDD? If the PDD does not specify the frequency of calibration, does the selected frequency represent good monitoring practise?	Meter is calibrated as per ISO 9001 Procedure no C09NA revision 1 “Calibration Procedures” of African Explosives Ltd.
Company performing the calibration:	African Explosives Ltd.
Did calibration confirm proper functioning of monitoring equipment? (Yes / No):	Calibration of operating parameters before the start of this campaign (April 2011) is missing, so last calibration was performed in November 2010. This has no impact on emission reduction calculations in the monitoring period (ref. CL3).
Is(are) calibration(s) valid for the whole reporting period?	Yes. /18/ /19/
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 /3/. Random picked data points were checked against data stored on the monitoring PC (during 1st verification period).

Does the data management (from monitoring equipment to emission reduction calculation) ensure correct transfer of data and reporting of emission reductions and are necessary QA/QC processes in place?	OK. All activities are regulated by QA/QC Procedures. The data are automatically stored in the SCADA Data Acquisition System. Once a month the results will be downloaded from SCADA to an excel file for analysis and calculation. The raw data will be saved on a DAT device and will be stored in a strongbox in the IT office. All data necessary for the emission reduction calculation are digitally transferred from the Plant data system (SCADA) to the dedicated relational database management system (N.DBMS).
In case only partial data are available because activity levels or non-activity parameters have not been monitored in accordance with the registered monitoring plan, has the most conservative assumption theoretically possible been applied or has a request for deviation been approved?	NA

APPENDIX D

CURRICULA VITAE OF THE VERIFICATION TEAM MEMBERS

***Patrice Massicard** holds a Master degree in Mechanical Engineering and has an overall experience of around 10 years. Prior to joining DNV, having around 3 years' experience in Oil & Gas industry and 5 years' experience in mechanical industry covering equipment design. He has experience of around 2 years in DNV for the certification of oil & gas processing equipments, and 2 years experience in the validation and verification of CDM projects. His qualification, industrial experience and experience in CDM demonstrate him sufficient sectoral competence in the filed oil & gas and mechanical industries.*

***Fahad Saleem** holds a Master Degree in Chemical Engineering. He has an overall experience of 3.5 years. Prior to joining DNV, he has 3 years' experience in Fertilizer industry covering plant operation.*

He has an experience of around 6 months in validation and verification of CDM/JI projects and other 3rd party validation/verification services.

His qualification, industrial experience and experience in CDM demonstrate his sufficient sectoral competence in TA 5.1/11.1/12.1.

***Lin Wu** holds a Master Degree in Chemical Engineering & Process, a Bachelor Degree in Chemical Engineering & Process and a Bachelor Degree in Computer Science & Technology, having an overall experience of around seven years. Prior to joining DNV, he has around four years experience in chemical industry covering design of chemical process and system, piping design, commissioning and project management on site. His experience also covers the fields of desulphurization of flue gas in power plant industry.*

He has experience of around 4 years in validation and verification of CDM/JI projects and other 3rd party validation/verification services.

His qualification, industrial experience and experience in CDM demonstrate his sufficient sectoral competence in "Energy Generation from Renewable Energy Sources" and "Chemical Processes Industries".