Monitoring report form
(Version 04.0)

Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.

MONITORING REPORT

Title of the project activity	Project for the catalytic reduction of N2O emissions with a secondary catalyst inside the ammonia reactor of the nitric acid plant at Dongbu Hannong Chemicals Ltd., Ulsan, Korea ("Dongbu")
Reference number of the project activity	1443
Version number of the monitoring report	01
Completion date of the monitoring report	31/03/2015
Registration date of the project activity	01/04/2008
Monitoring period number and duration of this monitoring period	- Number: 6 - Duration: 08/11/2011 – 04/06/2013
Project participant(s)	See table below
Host Party(ies)	Republic of Korea
Sectoral scope and selected methodology(ies), and where applicable, applied standardized baseline(s)	- Sectoral scope: Chemical industries (5) - AM0034 (Version 2)
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	252,519 tCO_2e
Actual GHG emission reductions or net	215,107 tCO_2e

Name of Party involved	Project Participants	Party involved considered as project participant
Republic of Korea (host)	- UPC Corporation Ltd. - Dongbu Hitek Co., Ltd.	No
United Kingdom of Great Britain and Northern Ireland	- Johnson Matthey PLC - N.serve Environmental Services GmbH	No
Switzerland	- Dongbu HiTek Co., Ltd. - UPC Corporation Ltd. - N.serve Environmental Services GmbH	No

anthropogenic GHG removals by sinks achieved in this monitoring period	
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	177,679 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	37,428 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Purpose of the project activity and measures taken to reduce GHG emissions

The sole purpose of the project activity is to significantly reduce former levels of N_2O emissions from the production of nitric acid at the Ulsan fertilizer factory's nitric acid plant owned by Dongbu HiTek Co., Ltd. in Ulsan, Republic of Korea, by implementation of a secondary N_2O abatement catalyst.

Brief description of the installed technology and equipments

The employed secondary N_2O abatement catalyst technology is supplied by Johnson Matthey PLC. Continuous monitoring of emission reductions is assured by a state of the art Automated Measuring System (AMS), consisting of stack gas volume flow meter, N_2O Analyzer, and respective data logging facilities. The AMS as well as its installation complies with the requirements of the European Standard EN 14181 as required by the methodology.

Relevant dates for the project activity

Registration Date:	01/04/2008
Crediting Period:	10 years fixed (01/04/2008 – 31/03/2018)
Installation of AMS:	29/01/2007
Baseline Campaign:	06/04/2007 – 14/06/2007
Earlier Project Campaigns:	PC 1 26/02/2008 – 15/05/2008
	PC 2 26/05/2008 – 24/08/2008
	PC 3 28/08/2008 – 07/01/2009
	PC 4 18/01/2009 – 23/04/2009
	PC 5 26/04/2009 – 05/08/2009
	PC 6 07/08/2009 – 15/10/2009
	PC 7 16/10/2009 – 04/01/2010
	PC 8 05/01/2010 – 20/04/2010
	PC 9 21/04/2010 – 26/07/2010
	PC 10 27/07/2010 – 20/10/2010
	PC 11 21/10/2010 – 04/01/2011
	PC 12 05/01/2011 – 19/03/2011

PC 13 20/03/2011 – 07/06/2011
PC 14 08/06/2011 – 12/08/2011
PC 15 16/08/2011 – 08/11/2011

Project Campaigns covered by current Monitoring/Verification Period:

PC 16 08/11/2011 – 26/01/2012
PC 17 27/01/2012 – 09/04/2012
PC 18 10/04/2012 – 20/06/2012
PC 19 21/06/2012 – 07/09/2012
PC 20 08/09/2012 – 11/11/2012
PC 21 12/11/2012 – 05/03/2013
PC 22 06/03/2013 – 04/06/2013

Total emission reductions achieved in this monitoring period
The total amount of emission reductions achieved in this monitoring period is **215,107 tCO_2e**.

A.2. Location of project activity

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Host Party: Republic of Korea
Region/State/Province: Nam-ku
City/Town/Community: Ulsan
Address: #523, Maeam-dong, Nam-ku, Ulsan, 680-050, Republic of Korea
Physical/Geographical location: 35°31°09.33 North; 129°21°59.13 East

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Korea (host)	- UPC Corporation Ltd. - Dongbu Hitek Co., Ltd.	No
United Kingdom of Great Britain and Northern Ireland	- Johnson Matthey PLC - N.serve Environmental Services GmbH	No
Switzerland	- Dongbu HiTek Co., Ltd. - UPC Corporation Ltd. - N.serve Environmental Services GmbH	No

A.4. Reference of applied methodology and standardized baseline

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a) AM0034 “Catalytic reduction of N2O inside the ammonia burner of nitric acid plants” Version 2

   For the baseline selection: AM0028 “Catalytic N2O destruction in the tail gas of Nitric Acid or Caprolactam Production Plants” Version 03

b) “Tool for the demonstration and assessment of additionality” Version 2

A.5. Crediting period of project activity

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Type: Non-renewable crediting period
Start date: 01/04/2008
End date 31/03/2018
Length: 10 years 0 months

A.6. Contact information of responsible persons/ entities

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Organization name	N.serve Environmental Services GmbH
Street/P.O. Box	Grosse Theaterstr. 14
Building	-
City	Hamburg
State/Region	Hamburg
Postcode	20354
Country	Germany
Telephone	+494030997860
Fax	+4940309978610
E-mail	contact@nserve.net
Website	www.nserve.net
Contact person	Nikolaus Gutknecht-Stöhr
Title	Head of Portfolio Management
Salutation	Mr
Last name	Gutknecht-Stöhr
Middle name	
First name	Nikolaus
Department	Portfolio Management
Mobile	+49163 314 2825
Direct fax	+4940309978610
Direct tel.	+4940309978615
Personal e-mail	gutknecht@nserve.net

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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Description of the installed technology, technical processes and equipment

The project activity entails the installation and implementation of the following technical equipment and quality measures:

1.) state-of-the art secondary N_2O abatement technology
2.) state-of-the-art Automated Monitoring System (AMS) for continuous N_2O measurement which is fully in compliance with European Standard EN 14181
3.) training of local staff on installation, operation and maintenance of catalyst and monitoring equipment, etc. as well as implementation of quality check and quality assurance measures

Catalyst Technology

Dongbu has contracted with Johnson Matthey PLC to install a secondary catalyst system that consists of a standard precious metal gauze pack with an additional base metal catalyst.

The precious metal gauze pack – i.e. the primary catalyst required for the actual production of nitric acid – has been supplied to Dongbu by Johnson Matthey for a number of years. The design, composition and weight of that gauze pack remain unchanged during the crediting period of the project.

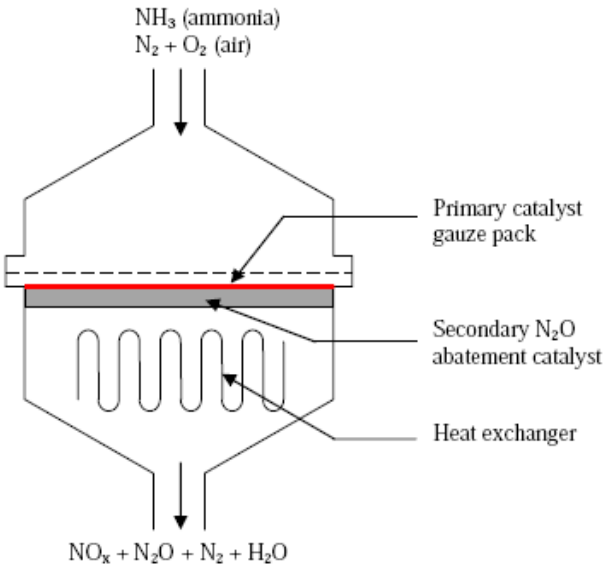
The secondary catalyst reduces N_2O levels in the gas mix resulting from the primary ammonia oxidation reaction based on the following reaction:

$2N_2O \rightarrow 2N_2 + O_2$

The secondary abatement catalyst does not contaminate the nitric acid produced in the respective nitric acid plant and does not require additional heat or other energy input, because the temperature levels present inside the Ammonia Oxidation Reactor suffice to ensure its optimum abatement efficiency. There are no additional greenhouse gases or other emissions generated by the reactions on at the N_2O abatement catalyst.

N_2O abatement catalyst installation

The secondary catalyst itself is easily installable during a routine plant shut-down and gauze change. The pellets are poured into the support basket / heat shield arrangement and raked level. The gauze pack is then installed above this bed using the support mechanism provided by the heat shield.



Dongbu's nitric acid plant operates at high pressure of between 13.25 and 14.75 bar inside the ammonia oxidation reactor.

Information on the implementation and actual operation of the project activity, including relevant dates

1. After installation of the AMS (January 2007) and successful performance of the baseline campaign from 06/04/2007 to 14/06/2007 the secondary N_2O abatement catalyst was installed and the project started regular operation on 26/02/2008 (start of first campaign with installed N_2O abatement). The registration of the project on 01/04/2008 is also starting date for the 10 years fixed crediting period.

According to the registered PDD Dongbu has contracted with Johnson Matthey PLC to install its Amoxis Hybrid® RN20/101 N_2O reduction catalyst from the start of the project. In order to optimize the abatement performance of the secondary catalyst Johnson Matthey recommended changing to a different type of secondary catalyst.

In a stepwise procedure the Amoxis Hybrid® RN20/101 catalyst was exchanged against a different type of N_2O abatement catalyst (YARA 58-Y1 catalyst). The change was performed in three steps:

18/01/2009:	6%	of YARA and	94 %	of Amoxis
02/03/2009:	31%	of YARA and	69 %	of Amoxis
09/04/2009:	100%	of YARA and	0 %	of Amoxis

Because N_2O is solely formed in the primary ammonia oxidation catalyst, the type of secondary catalyst has no effect on baseline emissions or on the baseline scenario. Moreover, as the costs for the new secondary catalyst are the same as for the previous type of secondary catalyst the change has also no effect on the additionality test of the project[1].

2. As to the characteristics of this specific project type certain production related events and incidents may affect the performance of the project or influence the monitoring of emission reductions (e.g. AMS down-time, etc). The table below lists relevant events and incidents related to production and/or emission monitoring which have occurred during actual operation within this specific monitoring period:

Start date and hour	End date and hour	Campaign	Short Description

Besides the above stated monitoring events no further AMS down-time within this monitoring period occurred.

3. No events or incidents of any relevance in regard to impacting the applicability of the methodology occurred during this monitoring period.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

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No temporary deviations from the registered monitoring plan or applied methodology have been applied during this monitoring period.

B.2.2. Corrections

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No corrections to project information or parameters fixed at validation have been approved during this monitoring period or submitted with this monitoring report.

B.2.3. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

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No permanent changes from the registered monitoring plan or applied methodologies have been approved during this monitoring period or submitted with this monitoring report.

[1] This change of secondary catalyst was accepted by the EB. Please refer to B.2.4. “Notification or request of approval of changes”.

A permanent change of the monitoring plan for the last monitoring/verification period was applied for the measurement of Nitric Acid Production (NAP) and has been accepted by the EB effective 11/05/2012. In the past (for the previous four monitoring periods) NAP had been determined following a multi-source-mass-balance approach which has shown to require a lot of efforts for providing respective evidence for accuracy. Thus Dongbu HiTek Co., Ltd. has decided to install a new coriolis mass flow meter (was installed 25/06/2010) in order to provide for a more transparent and more accurate means of measurement of the produced nitric acid.

B.2.4. Changes to project design of registered project activity

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No changes to project design of the project activity have been approved during this monitoring period or submitted with this monitoring report.

A notification of approval of change to the project activity described in the original registered CDM-PDD has been made and was accepted by the EB on 07/07/2010 (date for acceptance of "new" approved PDD). The approved change was made related to using a different type of secondary N_2O abatement catalyst, which is also supplied by the original supplier Johnson Matthey.

B.2.5. Changes to start date of crediting period

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No changes to the start date of the crediting period have been approved during this monitoring period or submitted with this monitoring report.

B.2.6. Types of changes specific to afforestation or reforestation project activity

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Not applicable

SECTION C. Description of monitoring system

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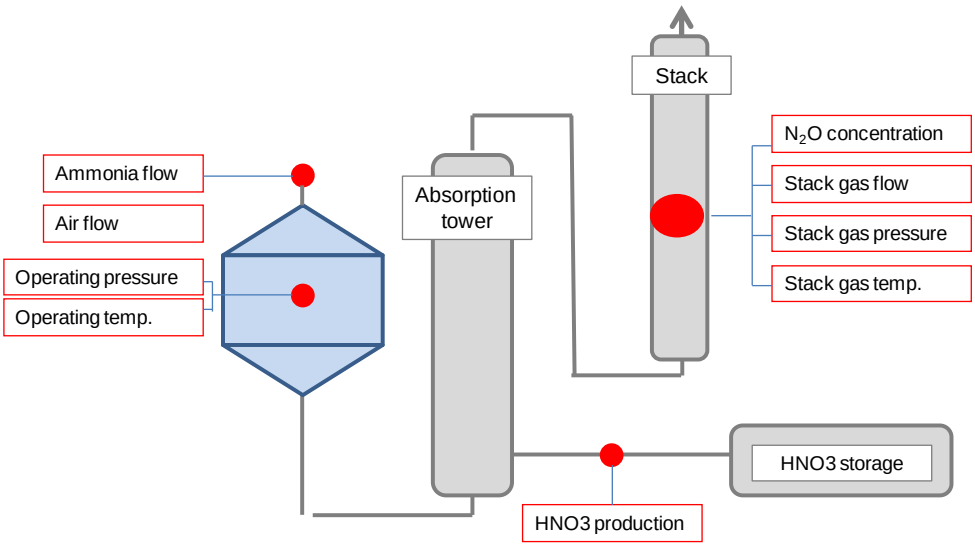
The monitoring system includes parts of monitoring equipment that is used for regular process control as well as the AMS (Automated Monitoring System) which had been installed on the sole purpose of emission (reduction) monitoring under this CDM project. The below diagram indicates the main measurement points, whereas Ammonia flow, Air flow, Operating Pressure and Temperature as well as the Nitric Acid (HNO_3) production are regular process parameter while N_2O concentration (NCSG), Stack Gas Flow (VSG), Stack Gas Temperature (TSG) and Stack Gas Pressure (PSG) are the parameters measured by the AMS.



1. General Description of the AMS

Dongbu's nitric acid plant is equipped with a state of the art AMS consisting of a MGA3000 NDIR Continuous Emissions Analyzer from ADC Ltd., Permapure Mini-GASS 1228 sample conditioning system and a custom made, multiple point pitot tube Systec DF25. The sample points were chosen in accordance with the AMS requirements and the plant design specifications to allow an optimum of data collecting quality.

2. Sample points

The location of the sample point was selected to provide ease of access and a location close to the analyzer. The most suitable position is in the vertical section of the exit stack. At this point, the gas is still hot (above dew point) and well mixed. The sampling points for both the NCSG and VSG are at least 3 times the stack diameter distance after any previous bend in the stack and behind the tail gas expander turbine.

3. N_2O Gas Analyzer

Baseline Campaign: ADC MGA3000 NDIR Gas Analyzer

At the time of conducting the baseline campaign (06/04/2007 – 14/06/2007) an ADC *MGA3000 NDIR Gas Analyzer* for the measurement of N_2O concentration in the stack gas was installed as part of the AMS.

Project Campaigns: ABB AO2000 URAS 26 gas analyzer

A new N_2O analyzer type ABB AO2000 URAS 26[2] was installed in February 2008 before the start of the first project campaign. This new gas analyzer also incorporates the NDIR measurement technology and is in full compliance with the requirements of the QAL1, which was successfully tested by TÜV SÜD Industrie Service GmbH, Germany[3].

4. Sample Conditioning System Permapure Mini-GASS 1228

- Heated sample gas probe with downstream filter integrated with dryer
- Effective insulation and protection shield
- Self-regulating up to 180 °C with low temperature alarm
- Dust concentration up to 2 g/m³
- 24 inch heated permeation dryer assembly remove water to -10 °C dew point
- requires either dry air or nitrogen 60 litres/min/70 psi
- full interlock to prevent sample pump damage

Technical Data:

- Material 1.4571
- Seals Graphite/1.4404 and see filter elements
- Operating temperature max. 200°C
- Maximum working pressure 6 bar
- Voltage 115/230 V, 50/60 Hz
- Low temp. alarm contact is open at operating temperature, closes at < 140 °C, current max. 4 A
- Ambient temperature -20 to +80 °C
- IP65 enclosure for weather protection

5. Flow Meter

The installed *delta-flow DF25* is a dynamic pressure probe which measures the flow in conduits according to the differential pressure principle. The probe is a multiple point pitot tube and with two different chambers, between which a pressure difference, caused by the flow in the duct, builds up. The differential pressure resulting at the probe is proportional to the square of the gas speed. Due to the probe's special shape, a highest possible differential pressure is produced, whereby the linearity of the measuring signal is guaranteed.

[2] AO2000 is the Analyzer type, however, the actual name is AO2020 indicating horizontal installation

[3] TÜV Süd Industrie Service GmbH, München (report number 821029) June 2006

The measurement results are converted from operating to standard conditions by taking temperature and pressure at the sample point into account.

The *delta-flow DF25* measurement device is approved in Germany for use in large combustion waste incineration plants (equivalent to QAL1 test[4]), which was confirmed during the AST conducted by Müller-BBM in May 2009.

6. Monitoring Plan

General description of the monitoring plan

The emission reductions achieved by the project activity are monitored based on the approved monitoring methodology AM0034 (Version 2). It is the appropriate monitoring methodology to be used in conjunction with the baseline methodology AM0034, "Catalytic reduction of N_2O inside the ammonia burner of nitric acid plants". Its applicability depends on the same prerequisites as the mentioned baseline methodology.

Methodology AM0034 requires the use of the European Standard EN 14181 (2004) *"Stationary source emissions - Quality assurance of automated measuring systems"*[5] as a guidance[6] for installing and operating the Automated Monitoring System (AMS) in the nitric acid plants for the monitoring of N_2O emissions.

A complete Automated Monitoring System (AMS) to monitor the mass emissions of N_2O at the stack of Dongbu's nitric acid plant was commissioned in 2006 and installed before start of the baseline campaign. In February 2008 the initially installed N_2O analyzer was replaced by a different type.

As an operator of nitric acid plants for many years, Dongbu staff in general and its Instrument Department in particular is accustomed to operating technical equipment to a high level of quality.

The plant manager is responsible for the ongoing operation and maintenance of the N_2O monitoring system. Operation, maintenance, calibration and service intervals are being carried out by staff from the instrumentation department according to the vendor's specifications and under the guidance of internationally relevant environmental standards, in particular EN 14181 (2004) and EN ISO 14956 (2002). In addition the supplier of the N_2O analyzer (I&A) company provides service and maintenance for the analyzer at regular intervals.

All monitoring procedures at Dongbu are also conducted and documented in accordance with well established procedures under the implemented ISO 9001 system which is regularly audited by an independent auditing firm accredited for ISO 9001 certification.

The monitoring software connected to the AMS at Dongbu derives hourly averages for all of the monitored parameters and delivers these data to N.serve, which is responsible for the correct analysis of the delivered data in accordance with the methodology.

Application of EN 14181 procedures to the project

The procedures as given in EN 14181 related to QAL1, QAL2 and QAL3 are practically applied at Dongbu nitric acid plant by the following means:

<u>QAL1</u>

In accordance with EN 14181 an AMS shall have been proven suitable for its measuring task (parameter and composition of the flue gas) by use of the QAL1 procedure as specified by EN ISO 14956. Using this standard, it shall be proven that the total uncertainty of the results obtained from the AMS meets the specification for uncertainty stated in the applicable regulations. Such suitability testing has to be carried out under specific conditions by an independent third party on a specific testing site.

[4] TÜV Umwelttechnik GmbH, Unternehmensgruppe TÜV Bayern, Nr. 24013115, date: 01/03/1996)

[5] This standard describes the quality assurance procedures needed to assure that an Automated Measuring System (AMS) installed to measure emissions to air are capable of meeting the uncertainty requirements on measured values given by legislation, e.g. EU Directives, or national legislation, and more generally by competent authorities.

[6] See page 8, last paragraph of AM0034 version 2: "The monitoring system is to be installed using the guidance document EN 14181 …"

The AMS consisting of the ABB AO2000 URAS 26 gas analyzer[7] and the delta-flow DF25 volume flow meter fulfill the requirements of QAL1[8/9]. Moreover was the analyzer provided by the local ABB distributer company I&A (Instrument & Analyzer), Ulsan, a local company, thus being able of providing service and maintenance for the analyzer at regular intervals.

QAL2 and Standard Reference Measurements (SRM)

QAL2 is a procedure for the determination of the calibration function and its variability, and a test of the variability of the measured values of the AMS compared with the uncertainty given by legislation. The QAL2 tests are performed on suitable AMS that have been correctly installed and commissioned on-site (as opposed to QAL1 which is conducted off-site). QAL2 tests are to be performed at least every 5 years according to EN 14181 but also after major changes to the plant or changes or repairs to the AMS, which will influence the results obtained significantly.

A calibration function is established from the results of a number of parallel measurements performed with a Standard Reference Method (SRM). The variability of the measured values obtained with the AMS is then evaluated against the required uncertainty. According to EN 14181, both the QAL2 procedures and the SRM need to be conducted by an independent testing house or laboratory accredited to EN ISO/IEC 17025.

A series of QAL2 specific reference measurements using a the SRM method as per EN 14181 for guidance has been carried out at Dongbu in March and June 2007 by an accredited testing house (SGS Environmental Services, Netherlands) to ensure the AMS' suitability, establish the calibration curve and test the variability of the measurements. The results of these SRM are available to the DOE as part of the verification process. The AMS calibration function as well as the total uncertainty of the AMS was determined, and the results were applied in the calculation of EF_{BL}.

After the installation of the new N_2O analyzer in February 2008, a new QAL2 test was performed for the analyzer by Müller-BBM GmbH, Germany (accredited testing laboratory according to ISO/IEC 17025) in March 2008 and again in May 2010. The tests were performed according to EN 14181 in order to ensure the AMS' suitability, establishing the calibration curve and test the variability of the measurements. The results were applied in the respective calculations of EF_n.

Annual Surveillance Tests (AST) have successfully been performed by an accredited testing house in years between QAL2 tests. The tests were performed in accordance with EN 14181. The AST is a series of measurements that need to be conducted by independent measurement equipment in parallel to the existing AMS.

AMS calibration and QA/QC procedures

Dongbu is certified according to ISO 9001 standards for quality management. The procedures for monitoring, regular calibrations and QA/QC are fully embedded into the procedures required by ISO 9001 and documented in the applicable ISO handbooks.

Analyzer Zero and Span Calibrations

Zero and span checks are conducted manually at least every 3 weeks. For the zero check pure nitrogen is used, for the span check a certified calibration gas is used. The results of the calibrations are recorded according to the related CDM procedure.

Calibration Gas

A certified N_2O Calibration gas (balance being N_2) with a precision of ±2% is used in the span calibrations. The calibration gas is certified by the manufacturer.

Training

Operations staff at the nitric acid plant who are responsible for the operation of the AMS and regular calibrations, visual and physical checks have been trained appropriately by the AMS vendors and Dongbu's own instrumentation engineers.

QAL3

[7] AO2000 is Analyzer type, however, the actual name is AO2020 indicating horizontal installation

[8] TÜV Umwelttechnik GmbH, Unternehmensgruppe TÜV Bayern, Nr. 24013115, date: 01/03/1996)

[9] TÜV Süd Industrie Service GmbH, München (report number 821029) June 2006

QAL3 is a procedure which is used to check drift and precision in order to demonstrate that the AMS is in control during its operation so that it continues to function within the required specifications for uncertainty.

This is achieved by conducting periodic zero and span checks on the analyzer and then evaluating the results obtained using control charts. Zero and span adjustments or maintenance of the analyzer, may be necessary depending on the results of this evaluation. The periodic zero and span calibration checks are conducted by Dongbu personnel. Results of periodic calibrations are analyzed graphically with the aid of simplified Shewart charts. The documentation of the above mentioned periodic calibrations show that the analyzer was operating within the requirements on the drift evaluation as included in the QAL2 test.

A specific procedure was developed according to which in case of unusual calibration observations an investigation on the reason for that event is triggered and an increased calibration frequency is used until the problem is solved. In addition, Annual Surveillance Tests (AST) are conducted in accordance with EN 14181, these are a series of measurements that need to be conducted by independent measurement equipment in parallel to the existing AMS.

Data acquisition system

Dongbu operates one data acquisition system that accumulates the analogue plant operating data from the Process Control System (PCS) into a PC (OT_h, OP_h, AFR, Air Flow, and AIFR). The analyzer unit contains its own CPU which receives the NCSG and VSG data (all converted from 4 - 20 mA analogue data into digital signal). This CPU will store the 2 second raw data of up to 5 years of operation. Then the CPU generates minute-by-minute average values from this raw data which are sent via Ethernet cable to a PC in the control room that also records the plant operating data.

Also from the plant operating data (OT_h, OP_h, AFR, Air Flow, and AIFR) minute-by-minute average values are generated in order to match the per minute average data records for NCSG and VSG.

To obtain the results for stack gas flow VSG (Nm^3/h) at normal conditions (101.325 kPa and 0 °C) from measured differential pressure the instrument equation – taken from the AMS manual – is used which includes pressure (PSG) and temperature (TSG) correction. During the QAL2 and AST the correct implementation of the correction function of VSG measurements to standard conditions was audited by independent testing laboratories (accredited to EN ISO/IEC 17025; SGS and Müller-BBM). During the tests VSG values were compared to the results obtained from measurements by the standard reference method.

As a result, there are now two sets of records on minute-by-minute average basis:

- Plant operation data (OT_h, OP_h, AFR, Air Flow, AIFR)
- Emissions Data (NCSG, VSG)

From these two files the hourly average values are extracted and converted into EXCEL format to get a complete data set which is then imported into the N.serve Database Management System (N.DBMS).

The production of final nitric acid at 100% concentration is determined on a daily basis separately recorded and reported.

Description of the N.serve Database Management System (N.DBMS)

All data necessary for the monitoring and verification procedures related to the project activity are transferred from the nitric acid plant's data acquisition system into 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. N.serve's monitoring specialists are responsible for the correct data handling and processing.

After data inspection and plausibility check, the provided monitoring data is transferred from the received excel files into the N.DBMS (Microsoft Access Program) for the analysis in accordance with AM0034. The results of this analysis are then exported into excel again where the final calculations are undertaken to derive EF_{BL} and EF_P which will then be used in the Monitoring Reports prepared by N.serve.

Prior to the start of the CDM project activity at Dongbu, the plant operating parameters were only recorded in handwritten log-books as spot values taken every two hours. As described in the PDD, the historic campaigns' operating parameters have been derived from these log-books.

The use of the N.DBMS system is described in the PDD and therefore part of the validated monitoring plan. However for the purpose transparency and easy cross checks all calculations are provided in an EXCEL calculation sheet.

All of the data obtained and used as part of the baseline and during the crediting period of the project will be archived electronically at least 2 years after the end of the crediting period of the project activity in at least two different locations.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

(Copy this table for each piece of data and parameter.)

Note: Validation of historic and baseline campaign data as well as determination of the baseline emission factor has been within the scope of the 1st periodic verification (see verification report of 1st periodic verification). The below tables refer to the actual values which have been verified/validated during the 1st periodic verification. However as a consequence of this the actual values for all baseline and historic campaign related parameters may be different to those stated in the registered PDD (e.g. OPh was measured in kPa and not kg/m2 as indicated in the PDD).

Data / Parameter:	**$NCSG_{BC}$**
Unit:	**mg/Nm^3**
Description:	N_2O concentration in the stack gas during the baseline campaign.
Source of data:	NDIR N_2O gas analyzer (ADC MGA 3000 gas analyzer)
Value(s) applied):	Value applicable for **regular project campaigns** exceeding CL_{normal} CL_{BL}: **3,282** Value applicable for **Project Campaign:** **PC 16: 3,282** **PC 17: 3,282** **PC 18: 3,282** **PC 19: 3,282** **PC 20: 3,248** **PC 21: 3,282** **PC 22: 3,247**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	

Data / Parameter:	**VSG_{BC}**
Unit:	**Nm^3/h**
Description:	Normal gas volume flow rate of the stack gas during the baseline campaign.
Source of data:	Gas Volume Flow meter, Systec Controls, Deltaflow DF25
Value(s) applied):	**41,585**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	The stack gas volume measurements are normalized to standard conditions by parallel measurement of temperature (TSG) and pressure (PSG) of the stack gas.

Data / Parameter:	**TSG**
Unit:	**°C**
Description:	Temperature in the stack gas
Source of data:	Integrated Stack temperature probe (KDS 2000'S / FT - PT 100 sensor) as part of the stack gas volume flow meter (Systec Controls, Deltaflow DF25);

Value(s) applied):	**Not applicable**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	Used for normalization of stack gas volume flow.

Data / Parameter:	**PSG**
Unit:	**bar**
Description:	Pressure in the stack
Source of data:	Stack gas pressure probe integrated in the volume flow meter (Systec Controls, Deltaflow DF25).
Value(s) applied):	**Not applicable**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	Used for normalization of stack gas volume flow to standard conditions.

Data / Parameter:	**OH_{BC}**
Unit:	**hours**
Description:	Operating hours
Source of data:	Production log
Value(s) applied):	**1,506**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**NAP_{BC}**
Unit:	**$tHNO_3$**
Description:	Metric tonnes of 100% concentrated nitric acid produced during the baseline campaign.
Source of data:	Tank level measurements
Value(s) applied):	**19,026.6**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	Please refer to table NAP under section D.2 below for a more detailed description of NAP determination.

Data / Parameter:	**UNC**
Unit:	**%**
Description:	Calculated uncertainty of the overall Automated Monitoring System (AMS)
Source of data:	Calculation of combined uncertainty of the applied monitoring equipment
Value(s) applied):	**5.0**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**AFR**
Unit:	**tNH_3/h**
Description:	Mean Ammonia gas flow rate to the ammonia oxidation reactor
Source of data:	Orifice plate – Differential pressure measurement principle

Value(s) applied):	**Not applicable, monitored data of AFR will be used to determine if plant was operating outside of AFR_{max}**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**AFR_{max}**
Unit:	**tNH_3/h**
Description:	Maximum ammonia gas flow rate to the ammonia oxidation reactor
Source of data:	AFR data from historic campaigns
Value(s) applied):	**3.797**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	NOne

Data / Parameter:	**AIFR**
Unit:	**%**
Description:	Mean ammonia to air ratio into the ammonia oxidation reactor
Source of data:	Measurements of AFR and primary air flow rates
Value(s) applied):	**Not applicable, monitored data of AIFR will be used to determine if plant was operating outside of $AIFR_{max}$**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**$AIFR_{max}$**
Unit:	**%**
Description:	Maximum ammonia to air ratio into the ammonia oxidation reactor.
Source of data:	AIFR
Value(s) applied):	**0.08**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**CL_{BL}**
Unit:	**$tHNO_3$**
Description:	Length of the baseline campaign measured in metric tonnes of 100% concentrated nitric acid produced during the baseline campaign.
Source of data:	NAP_{BC}
Value(s) applied):	**19,026.6**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**CL_{normal}**
Unit:	**$tHNO_3$**
Description:	Average length of the historic campaigns measured in metric tonnes of 100% concentrated nitric acid produced during that baseline campaign.
Source of data:	Production logs

Value(s) applied):	**20,672**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**OT_{normal}**
Unit:	**°C (min and max)**
Description:	Normal range operating temperature during the 5 historic campaigns
Source of data:	Thermocouples inside Ammonia Oxidation Reactor (AOR).
Value(s) applied):	**907.3 and 932.0**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**OP_h**
Unit:	**kPa**
Description:	Oxidation Pressure for each hour.
Source of data:	Monitored by pressure transmitter.
Value(s) applied):	**Used to determine whether OP_h during baseline campaign falls outside OP_{normal}.**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**OP_{normal}**
Unit:	**kPa**
Description:	Oxidation Pressure for each hour during the five historic campaigns.
Source of data:	Monitored by pressure transmitter
Value(s) applied):	**1,087 – 1,284**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**GS_{normal}**
Unit:	**Name of Supplier**
Description:	Gauze supplier for the five historic campaigns
Source of data:	Monitored / Invoices
Value(s) applied):	**Johnson Matthey PLC**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**GS_{BL}**
Unit:	**Name of Supplier**
Description:	Gauze supplier for the baseline condition campaign
Source of data:	Monitored / Invoices
Value(s) applied):	**Johnson Matthey PLC**

Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**GC_{normal}**
Unit:	**%**
Description:	Gauze composition during the 5 historic operating campaigns expressed as percentage by weight of the precious metals Platinum, Rhodium and, if applicable, Palladium comprising the Ammonia Oxidation Catalyst gauzes.
Source of data:	Monitored / Gauze supplier invoices
Value(s) applied):	**Platinum (Pt) 90, Rhodium (Rh) 5, Palladium (Pd) 5**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**GC_{BL}**
Unit:	**%**
Description:	Gauze composition during the baseline campaign expressed as percentage by weight of the precious metals Platinum, Rhodium and, if applicable, Palladium comprising the Ammonia Oxidation Catalyst.
Source of data:	Monitored / Gauze supplier invoices
Value(s) applied):	**Platinum (Pt) 90; Rhodium (Rh) 5; Palladium (Pd) 5**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**EF_{reg}**
Unit:	**$tN_2O/tHNO_3$**
Description:	N_2O Emissions cap for N_2O from nitric acid production set by national government regulation.
Source of data:	Ministry of Environment
Value(s) applied):	**None**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	There is currently no regulation in the Republic of Korea that limits the emissions of N_2O from nitric acid production.

Data / Parameter:	**BE_{BC}**
Unit:	**tN_2O**
Description:	Total N_2O mass flow during baseline campaign.
Source of data:	Calculation from measured data.
Value(s) applied):	Value applicable for **regular project campaigns** exceeding CL_{normal} or CL_{BL}: **212.9** Value applicable for **Project Campaign:** **PC 16: 212.9** **PC 17: 212.9** **PC 18: 212.9** **PC 19: 212.9** **PC 20: 210.7** **PC 21: 212.9** **PC 22: 210.6**

Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

Data / Parameter:	**EF_{BL}**
Unit:	**$kgN_2O/tHNO_3$ ($tN_2O/tHNO_3$)**
Description:	N_2O Emission factor for baseline period
Source of data:	Calculated from measured data (tonnes of N_2O emitted / tonnes of nitric acid produced)
Value(s) applied):	Value applicable for **regular project campaigns** exceeding CL_{normal} and CL_{BL}: **10.63 (0.01063)**[10] Value applicable for **Project Campaign:** **PC 16: 10.63** **PC 17: 10.63** **PC 18: 10.63** **PC 19: 10.63** **PC 20: 10.52** **PC 21: 10.63** **PC 22: 10.51**
Purpose of data:	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment:	None

D.2. Data and parameters monitored

(Copy this table for each piece of data and parameter.)

Data / Parameter:	**NCSG**
Unit:	**mg/Nm^3**
Description:	N_2O concentration in the stack gas during each project campaign.
Measured/ Calculated / Default:	Measured/Calculated - every 2 sec. used for calculation of campaign mean (average, after exclusion of extreme values and outliers)
Source of data:	NDIR N_2O gas analyzer (ABB AO2000 Uras-26)
Value(s) of monitored parameter:	**PC 16: 1,656** **PC 17: 1,207** **PC 18: 1,175** **PC 19: 1,183** **PC 20: 1,553** **PC 21: 1,506** **PC 22: 1,775**

[10] This value is different from the value as stated in the PDD (0.01078) as to some corrections done after publication of the PDD. These changes and the baseline emission factor of 0.01063 $tN_2O/tHNO_3$ have been verified by DNV during the first verification.

Monitoring equipment:	Type: *NDIR N_2O gas analyzer (ABB AO2000 Uras-26)* Overall measurement accuracy: *±1%* Serial Number*:* *3.358769.7* Calibration frequency: *Determination or validation of calibration function is performed once every year: QAL2 test (determination) at least every 5 years + AST (validation) in years in between.* *In addition manual zero and span check/calibrations (QAL3) are carried out every three weeks by an external company (local representative of manufacturer of the N_2O Analyzer.* Date of last calibration: *1. QAL2 test according to EN 14181 performed by external laboratory with ISO/IEC 17025 accreditation (Müller BBM) 12/05/2010 - 14/05/2010, valid until 11/05/2015* *2. AST according to EN 14181 performed by external laboratory with ISO/IEC 17025 accreditation (Müller BBM) on 18/05/2011 - 19/05/2011, valid until 17/05/2012,* *3. AST according to EN 14181 performed by external laboratory with ISO/IEC 17025 accreditation (Müller BBM) on 30/05/2012,* valid until *29/05/2013* ***Calibration delay:*** The AST listed under 2. above was due on 11/05/2011, but was only conducted on 18/05/2011. The delay of the AST was prior to this monitoring period and has no effect on this monitoring period. The AST listed under 3. above was due on 18/05/2012, but was only conducted on 30/05/2012. In order to adhere the guidelines for assessing compliance with the calibration frequency requirements as stipulated in paragraph 273 of VVS the maximum permissible error as stated by the equipment vendor of the instruments for NCSG and VSG were applied. The error was applied in a conservative manner for the period between the scheduled AST and the actual date of the AST. The error was applied for the period from 18/05/2012 to 29/05/2012. A new AST was due on 30/05/2013 as the AST listed under 3. above expired on 29/05/2013. The monitoring period ended on 04/06/2013 and the catalyst was de-installed after that date due to the fact that the price level for CERs was too low to justify continuous operation of the project. As a result, no AST was conducted since. The AMS was considered non-functional and the maximum values for NCSG and VSG of the relevant campaign (PC22) were used for the time period in question.
Measuring/ Reading/ Recording frequency:	Continuously (every 2 seconds).

Calculation method (if applicable):	NCSG is continuously monitored and recorded every 2 seconds. Hourly mean values for NCSG are derived from the collected data. NCSG data taken during times when the respective plant was out of operation are eliminated. Before any further analysis the hourly mean values are corrected by the relevant correction factor as determined during the latest QAL2 (CF_{NCSG} = 1.017). Since the analyzer reads ppmv (parts per million in volume); in order to obtain mg/Nm^3 the values are transferred by application of the following equation: $NCSG = ppmv * \frac{RMM}{v}$ where: *NCSG* is N_2O concentration in the stack gas (mg/Nm^3) *ppmv* means parts per million in volume *RMM* means relative molecular mass of N_2O (44.013 mg) *v* means standard volume of an ideal gas (22.4 Nm^3) The resulting hourly average NCSG values are now expressed in mg/Nm^3 as required by AM0034. Subsequently the following statistical analysis is applied: a) Calculate the sample mean (x) b) Calculate the sample standard deviation (s) c) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation) d) Eliminate all data that lie outside the 95% confidence interval e) Calculate the new sample mean from the remaining NCSG values
QA/QC procedures:	Manual zero and span checks, AST and QAL2 test according to EN 14181. QAL3 procedures according to EN 14181 applied through documentation and evaluation by Shewart charts.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**VSG**
Unit:	**Nm^3/h**
Description:	Normal gas volume flow rate of the stack gas during each project campaign.
Measured/ Calculated / Default:	Measured/Calculated - every 2 sec. used for calculation of campaign mean (average, after exclusion of extreme values and outliers)
Source of data:	Gas Volume Flow meter, Systec Controls, Deltaflow DF25
Value(s) of monitored parameter:	**PC 16: 47,226** **PC 17: 47,029** **PC 18: 46,506** **PC 19: 45,680** **PC 20: 47,475** **PC 21: 46,628** **PC 22: 45,739**

Monitoring equipment:	Type: *Tail Gas Volume Flow meter, Systec Controls, Deltaflow DF25 with integrated temperature and pressure measurement, transmitter: Foxboro/Invensys, Annubar, model IVM 30* Overall measurement accuracy: *1.5%* Serial Number: *06460586/10546-01* Calibration frequency: *1. QAL2 test according to EN 14181 performed by external laboratory with ISO/IEC 17025 accreditation (Müller BBM) 12/05/2010 - 14/05/2010, valid until 11/05/2015* *2. AST according to EN 14181 performed by external laboratory with ISO/IEC 17025 accreditation (Müller BBM) on 18/05/2011 - 19/05/2011, valid until 17/05/2012,* *3. AST according to EN 14181 performed by external laboratory with ISO/IEC 17025 accreditation (Müller BBM) on 30/05/2012,* valid until *29/05/2013* ***Calibration delay:*** The AST listed under 2. above was due on 11/05/2011, but was only conducted on 18/05/2011. The delay of the AST was prior to this monitoring period and has no effect on this monitoring period. The AST listed under 3. above was due on 18/05/2012, but was only conducted on 30/05/2012. In order to adhere the guidelines for assessing compliance with the calibration frequency requirements as stipulated in paragraph 273 of VVS the maximum permissible error as stated by the equipment vendor of the instruments for NCSG and VSG were applied. The error was applied in a conservative manner for the period between the scheduled AST and the actual date of the AST. The error was applied for the period from 18/05/2012 to 29/05/2012. A new AST was due on 30/05/2013 as the AST listed under 3. above expired on 29/05/2013. The monitoring period ended on 04/06/2013 and the catalyst was de-installed after that date due to the fact that the price level for CERs was too low to justify continuous operation of the project. As a result, no AST was conducted since. The AMS was considered non-functional and the maximum values for NCSG and VSG of the relevant campaign (PC22) were used for the time period in question.
Measuring/ Reading/ Recording frequency:	Continuously (every 2 seconds).

Calculation method (if applicable):	VSG is continuously monitored with a flow meter and monitoring results are recorded continuously (every 2 seconds). The *SYSTEC Controls, Deltaflow DF25* with integrated Foxboro/Invensys IMV30 multivariable transmitter/calculator, (Annubar probe with multifunctional transmitter for pressure and temperature correction) combines differential pressure, static pressure and temperature measurement with an integral flow calculator to dynamically and continuously calculate all of the dp flow coefficients for fully compensated flow. The dp, stack temperature and stack pressure are measured and the normalized flow in standard conditions (273.15 K, 101.325 kPa) calculated directly in the instrument. The normalized flow measurements are recorded in the data acquisition system. Hourly means for VSG are derived by the data acquisition system. VSG data taken during times when the plant was operating outside the permitted operating range were eliminated. The resulting hourly average VSG values are now expressed in Nm^3/h as required by AM0034. At this stage the relevant a correction factor as determined during the latest QAL2 test is applied (CF_{VSG} = **1.11)**before the data is subject to the following statistical analysis: a) Calculate the sample mean (x) b) Calculate the sample standard deviation (s) c) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation) d) Eliminate all data that lie outside the 95% confidence interval e) Calculate the new sample mean from the remaining VSG values
QA/QC procedures:	AST and QAL2 according to EN 14181.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**TSG**
Unit:	**°C**
Description:	Temperature in the stack gas
Measured/ Calculated / Default:	Measured.
Source of data:	Integrated Stack temperature probe (KDS 2000'S / FT - PT 100 sensor) as part of the stack gas volume flow meter (Systec Controls, Deltaflow DF25)
Value(s) of monitored parameter:	Not applicable, directly used for normalization of tail gas volume flow measurement.
Monitoring equipment:	Temperature probe KDS 2000'S / FT - PT 100 sensor, integrated part of stack gas volume flow meter. *As integrated part of the tail gas volume flow meter the same specifications apply as for parameter VSG (see parameter table above).*
Measuring/ Reading/ Recording frequency:	Continuously (every 2 seconds).
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	See parameter table for VSG.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**PSG**
Unit:	**Bar**
Description:	Pressure in the stack
Measured/ Calculated / Default:	Measured.
Source of data:	Stack gas pressure probe integrated in the volume flow meter (Systec Controls, Deltaflow DF25).
Value(s) of monitored parameter:	Not applicable, directly used for normalization of tail gas volume flow measurement.
Monitoring equipment:	Stack gas pressure probe, integrated part of stack gas volume flow meter. *As integrated part of the tail gas volume flow meter the same specifications apply as for parameter VSG (see parameter table above).*
Measuring/ Reading/ Recording frequency:	Continuously (every 2 seconds).
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	See parameter table for VSG.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**PE_n**
Unit:	**tN_2O**
Description:	Total mass N_2O emissions in each project campaign.
Measured/ Calculated / Default:	Calculated.
Source of data:	Calculated from measured values.
Value(s) of monitored parameter:	**PC 16: 139.6** **PC 17: 98.2** **PC 18: 91.1** **PC 19: 86.0** **PC 20: 97.3** **PC 21: 114.3** **PC 22: 106.5**
Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	$PE_n = VSG * NCSG * 10^{-9} * OH$
QA/QC procedures:	Not applicable.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**OH_n**
Unit:	**Hours**
Description:	Total operating hours during each project campaign

Measured/ Calculated / Default:	Measured.
Source of data:	Production log.
Value(s) of monitored parameter:	**PC 16: 1,785** **PC 17: 1,731** **PC 18: 1,667** **PC 19: 1,592** **PC 20: 1,319** **PC 21: 1,628** **PC 22: 1,312**
Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Hourly.
Calculation method (if applicable):	Every hour of operation for which NAP is recorded is considered as an operational hour for the purposes of PE calculation. However, if the plant exceeds certain design parameters, it will automatically shut down ("trip limits"). Periods during the ongoing campaign during which the plant was considered not in operation will be eliminated from the determination of OH. The plant was considered to be not in operation when any of the following parameters are recorded outside the "trip" limits as determined by the plant manuals: AIFR > 0.081 (i.e. if the ammonia concentration in air is higher than 8.1%, the plant shuts itself off automatically. The trip value for AIFR given as 0.075 in the manual is actually representative of 0.075 units Ammonia in 1 unit of Air. Therefore, the trip value has to be recalculated as 0.075 / (1 - 0.075) = 0.081 in order for it to be comparable with the AFR/Air calculation) OP_h > 1,500 kPa The following additional criteria were applied to exclude any obviously nonsensical values and the corresponding operating hours (OH) eliminated: OT_h < 550 °C; AFR = 10 tNH_3/h (These values were chosen arbitrarily with a view to capture and exclude such values that where obviously not valid or nonsensical)
QA/QC procedures:	Not applicable.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**NAP**
Unit:	**$tHNO_3$**
Description:	Metric tonnes of 100% concentrated nitric acid during each project campaign.
Measured/ Calculated / Default:	Measured
Source of data:	Flow Meter, Laboratory analysis
Value(s) of monitored parameter:	**PC 16: 21,351** **PC 17: 21,921** **PC 18: 20,874** **PC 19: 19,624** **PC 20: 16,429** **PC 21: 20,484 (from which 8,110 in 2012 and 12,374 in 2013)** **PC 22: 16,130**

Monitoring equipment:	Type: ***Coriolis Mass Flow Meter*** *(Tag-Nr. FQI-1303)* Overall measurement accuracy: ± *0.1%* Serial Number: *14175882* Calibration frequency: *every three years* Date of last calibration: *the new Coriolis flow meter was installed on 05/07/2010;first periodic calibration relevant for this monitoring period was performed on: 07/06/2011* valid until: *06/06/2014*
Measuring/ Reading/ Recording frequency:	see below calculation method
Calculation method (if applicable):	NAP flow at actual concentration (as measured by the coriolis mass flow meter) multiplied with the nitric acid concentration (determined by temperature and density measurement in the laboratory once per day) results in NAP at 100%; $NAP_{actual} * Conc_{na} = NAP_{100\%}$
QA/QC procedures:	Regular calibration
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**EF_n**
Unit:	**$kgN_2O/tHNO_3$**
Description:	Emissions factor for campaign n.
Measured/ Calculated / Default:	Calculated.
Source of data:	Calculation from total mass N_2O emissions of campaign n (PE_n) and total nitric acid production (NAP_n).
Value(s) of monitored parameter:	**PC 16: 6.54** **PC 17: 4.48** **PC 18: 4.37** **PC 19: 4.47** **PC 20: 5.92** **PC 21: 5.58** **PC 22: 6.60**
Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	The campaign specific emissions factor for each campaign during the project's crediting period is calculated by dividing the total mass of N_2O emissions during that campaign by the total production of 100% concentrated nitric acid during that same campaign. For campaign *n* the campaign specific emission factor is: $EF_n = PE_n / NAP_n$
QA/QC procedures:	Not applicable.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**$EF_{ma,n}$**
Unit:	**$kgN_2O/tHNO_3$**
Description:	Moving average emissions factor derived over time from campaign specific emissions factors.

Measured/ Calculated / Default:	Calculated.
Source of data:	Calculation from project emission factors of all project campaigns.
Value(s) of monitored parameter:	**PC 16: 4.71** **PC 17: 4.70** **PC 18: 4.68** **PC 19: 4.67** **PC 20: 4.73** **PC 21: 4.77** **PC 22: 4.85**
Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	In order to take into account possible long-term emissions trends over the duration of the project activity and to take a conservative approach the moving average emission factor is determined as follows: $EF_{ma,n} = (EF_1 + EF_2 + \ldots + EF_n) / n$ This process is repeated for each campaign such that a moving average, $EF_{ma,n}$ is established over time, becoming more representative and precise with each additional campaign.
QA/QC procedures:	Not applicable.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**EF_p**
Unit:	**$tN_2O/tHNO_3$ ($kgN_2O/tHNO_3$)**
Description:	Emissions factor used for the specific campaign n to determine the emission reductions of that campaign
Measured/ Calculated / Default:	Calculated.
Source of data:	Calculation of EF_n and $EF_{ma,n}$.
Value(s) of monitored parameter:	**PC 16: 6.54** **PC 17: 4.70** **PC 18: 4.68** **PC 19: 4.67** **PC 20: 5.92** **PC 21: 5.58** **PC 22: 6.60**
Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	To calculate the total emission reductions achieved in a campaign, the higher of the two values $EF_{ma,n}$ and EF_n shall be applied as the emission factor relevant for the particular campaign to be used to calculate emissions reductions (EF_P). Thus: If $EF_{ma,n} > EF_n$ then $EF_P = EF_{ma,n}$ If $EF_{ma,n} < EF_n$ then $EF_P = EF_n$
QA/QC procedures:	Not applicable.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks

Additional comment:	

Data / Parameter:	**EF_{min}**
Unit:	**($kgN_2O/tHNO_3$**
Description:	EF_{min} is equal to the lowest EF_n observed during the first 10 campaigns of the project crediting period.
Measured/ Calculated / Default:	Calculated.
Source of data:	Calculation of EF_n.
Value(s) of monitored parameter:	**2.98**
Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	A campaign-specific emissions factor shall be used to cap any potential long-term trend towards decreasing N_2O emissions that may result from a potential built up of platinum deposits. After the first ten campaigns of the crediting period of the project, the lowest EF_n observed during those campaigns will be adopted as a minimum (EF_{min}). If any of the later project campaigns results in a EF_n that is lower than EF_{min}, the calculation of the emission reductions for that particular campaign shall used EF_{min} and not EF_n.
QA/QC procedures:	Not applicable.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**CL_n**
Unit:	**$tHNO_3$**
Description:	Length of each project campaign measured in metric tonnes of 100% concentrated nitric acid produced during that campaign.
Measured/ Calculated / Default:	Measured.
Source of data:	Calculation from project emission factors of all project campaigns.
Value(s) of monitored parameter:	**PC 16: 21,351** **PC 17: 21,921** **PC 18: 20,874** **PC 19: 19,624** **PC 20: 16,429** **PC 21: 20,484 (from which 8,110 in 2012 and 12,374 in 2013)** **PC 22: 16,130**
Monitoring equipment:	See description for NAP measurement
Measuring/ Reading/ Recording frequency:	See description for NAP measurement.
Calculation method (if applicable):	See description for NAP measurement.
QA/QC procedures:	See description for NAP measurement.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	

Data / Parameter:	**OP_h**
Unit:	**Bar**
Description:	Oxidation Pressure for each hour
Measured/ Calculated / Default:	Measured.
Source of data:	Monitored by pressure transmitter.
Value(s) of monitored parameter:	**Not applicable. Eventually used to determine whether the plant is in operation or not.**
Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Not applicable.
Purpose of data:	Not applicable.
Additional comment:	

Data / Parameter:	**OT_h**
Unit:	**°C**
Description:	Oxidation temperature in the ammonia oxidation reactor (AOR).
Measured/ Calculated / Default:	Measured.
Source of data:	Thermocouple inside Ammonia Oxidation Reactor (AOR)
Value(s) of monitored parameter:	**Not applicable. Eventually used to determine whether the plant is in operation or not.**
Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Not applicable.
Purpose of data:	Not applicable.
Additional comment:	

Data / Parameter:	**AFR**
Unit:	**tNH_3/h**
Description:	Ammonia gas flow rate to the ammonia oxidation reactor.
Measured/ Calculated / Default:	Measured.
Source of data:	Continuously measured by orifice plate.
Value(s) of monitored parameter:	**Not applicable. Eventually used to determine whether the plant is in operation or not.**

Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Not applicable.
Purpose of data:	Not applicable.
Additional comment:	

Data / Parameter:	**AIFR**
Unit:	**% v/v**
Description:	Ammonia to air ratio into the ammonia oxidation reactor
Measured/ Calculated / Default:	Calculated.
Source of data:	Calculation for each hour of plant operation based on measurements of AFR and primary air flow rates.
Value(s) of monitored parameter:	**Not applicable. Eventually used to determine whether the plant is in operation or not.**
Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Not applicable.
Purpose of data:	Not applicable.
Additional comment:	

Data / Parameter:	**$GS_{project}$**
Unit:	**Name of Supplier**
Description:	Gauze supplier for the project campaign
Measured/ Calculated / Default:	Not applicable.
Source of data:	Monitored / Invoices
Value(s) of monitored parameter:	**Johnson Matthey PLC**
Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Not applicable.
Purpose of data:	Not applicable.
Additional comment:	

Data / Parameter:	$GC_{project}$
Unit:	**%**
Description:	Gauze composition during the project campaign expressed as % by weight of the precious metals Platinum, Rhodium and, if applicable, Palladium comprising the Ammonia Oxidation Catalyst gauzes.
Measured/ Calculated / Default:	Not applicable.
Source of data:	Monitored / Gauze supplier invoices
Value(s) of monitored parameter:	**Platinum (Pt) 90, Rhodium (Rh) 5, Palladium (Pd) 5**
Monitoring equipment:	Not applicable.
Measuring/ Reading/ Recording frequency:	Not applicable.
Calculation method (if applicable):	Not applicable.
QA/QC procedures:	Not applicable.
Purpose of data:	Not applicable.
Additional comment:	

D.3. Implementation of sampling plan

>>
Not applicable

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>>
The results of the N.DBMS data analysis are exported to EXCEL spreadsheets for further analysis and presentation.

It should be noted that all values presented in excel tables are displayed (in the tables) as rounded values due to the function of excel as a program. However, actual calculations have been conducted using the exact values, which explains possible differences compared to calculating with the rounded parameter values as displayed in the tables. This applies to all presented excel tables not only those related to baseline emission calculations.

Analysis of Historical campaign data and determination of permitted operating ranges

The determination of the baseline parameters, the permitted operating conditions for operating temperature, operating pressure, maximum ammonia flow rate, maximum ammonia to air ratio, normal gauze supplier and normal gauze composition was undertaken by the verifying DOE (as it was clarified by the CDM EB in EB31 meeting that either the validating or verifying DOE could undertake the task of determination of the permitted operating conditions). The parameters derived from the five historic campaigns are the following:

Permitted operating conditions as validated in the course of the first periodic verification (see published verification report; Report No. 2008-1759 - Revision No. 2).		
OThmin	907.3	°C
OThmax	932.0	°C
OPhmin	1,087.5	kPa
OPhmax	1,283.9	kPa
AIFRmax	0.081	factor
AFRmax	3.797	t NH3 /h
CLnormal	20,672	t HNO3

Analysis of Baseline campaign data

The Baseline Campaign was conducted from 06/04/2007 to 14/06/2007.

Analysis of Baseline campaign data

The baseline campaign was in operation in the period 06/04/2007 to 14/06/2007. The baseline monitoring data, baseline calculation and baseline results were determined during the first verification and were verified by the DOE during the first verification.
The results are as follows:

Baseline Parameters as validated in the course of the first periodic verification (see published verification report; Report No. 2008-1759 - Revision No. 2).		
$NCSG_{BL}$	mg/Nm³	3,282.5
$QAL2_{\_NCSG}$	factor	0.945
VSG_{BL}	Nm³/h	41,585.3
$QAL2_{\_VSG}$	factor	1.096
OH_{BL}	h	1,506
NAP_{BL}	t HNO_3	19,026.6
BE	t N_2O	212.9
UNC	factor	5.0
EF_{BL}	kg N_2O/t HNO_3	10.63

Resulting EF_{BL}

The EF_{BL} derived from this analysis of historic and baseline data is 10.63 $kgN_2O/tHNO_3$.

Sample calculation for baseline emissions (BE) and Emission factor (EF):

BE [tN_2O] = 41,585.3 [Nm³/h] * 1.096 * 3,282.5 [mg/Nm³] * 0.945 * 10^{-9} * 1,506 [h] = 212.9 [tN_2O]
EF [$kgN_2O/tHNO_3$] = 212.9 [tN_2O] / 19,026.6 [$tHNO_3$] * 10^3 * (1 – 5.0/100) = 10.63 [$kgN_2O/tHNO_3$]

Note that small deviations occur due to rounding. Please refer to the calculation excel file for details.

Adjustment of Baseline Emission Factor if $CL_n < CL_{normal}$

If the length of an individual project campaign CL_n exceeds or is equal to the average historic campaign length CL_{normal} (20,672 $tHNO_3$), then all N_2O values measured during the baseline campaign can be used for the calculation of EF_{BL}. If $CL_n < CL_{normal}$, EF_{BL} has to be recalculated by eliminating those N_2O values that were obtained during the production of tonnes of nitric acid beyond the CL_n (i.e. the last tonnes produced) from the calculation of EF_{BL}. However, since the campaign length of the baseline campaign (CL_{BL}) was below CL_{normal} the actual threshold for factual adjustment of EF_{BL} is not presented by CL_{normal} but CL_{BL} at 19,026.6 $tHNO_3$.

For the project campaigns 16, 17, 18, 19, 21 the CL_n is longer than CL_{BL}, therefore no adjustment of the Baseline emissions factor EF_{BL} is necessary.

For the project campaigns 20 and 22 $CL_n < CL_{normal}$ and $CL_n < CL_{BL}$, EF_{BL} is recalculated by eliminating those N_2O values that were obtained during the production of tonnes of nitric acid beyond the CL_{BL} (i.e. the last tonnes produced) from the calculation of EF_{BL}. For PC 20, this was the case at 01/06/2007 18:00. All N_2O data measured later than this hour were excluded for the recalculation of EF_{BL}. For PC 22, this was the case at 31/05/2007 19:00. All N_2O data measured later than this hour were excluded for the recalculation of EF_{BL}.

The results are as follows:

		PC 20	**PC 22**
$NCSG_{BL}$	mg/Nm³	3,248	3,247
BE	t N_2O	210.7	210.6
EF_{BL}	**kg N_2O/t HNO_3**	**10.52**	**10.51**

Adjustment of Baseline emissions factor due to EF_{reg}

Should N_2O emissions regulations that apply to nitric acid plants be introduced in the host country or jurisdiction covering the location of the project activity, such regulations shall be compared to the calculated baseline emission factor for the project (EF_{BL}). If the regulatory limit is lower than the baseline factor determined for the project, the regulatory limit shall serve as the new baseline emission factor, that is:

if $EF_{BL} > EF_{reg}$,

then the baseline N_2O emission factor shall be EF_{reg} for all calculations.

where:

Variable Definition

EF_{BL} Baseline emissions factor ($tN_2O/tHNO_3$)
EF_{reg} Emissions level set by newly introduced policies or regulations ($tN_2O/tHNO_3$).

Such EF_{reg} shall be determined according to the nature of the regulation (e.g. in terms of absolute emission, by-product rate, concentration in stack gas), as described in the approved methodology AM0028.

There is currently no N_2O regulation for nitric acid plants in the Republic of Korea therefore no adjustment of the Baseline emissions factor EF_{BL} is necessary.

E.2. Calculation of project emissions or actual net GHG removals by sinks

>>

Project emissions are calculated according to the following formula:

$PE_n = VSG * NCSG * 10^{-9} * OH$

Variable	Definition
VSG	Mean stack gas volume flow rate for the project campaign (m^3/h)
NCSG	Mean concentration of N_2O in the stack gas for the project campaign (mgN_2O/m^3)
PE_n	Total N_2O emissions of the n^{th} project campaign (tN_2O)
OH	Is the number of hours of operation in the specific monitoring period (h)

Based on the total N_2O emissions of each project campaign the specific project campaign emission factor is calculated as:

$EF_n = PE_n / NAP_n$

Where:

Variable	Definition
EF_n	Project Emission Factor for n^{th} project campaign ($kgN_2O/tHNO_3$)
PEn	Total N_2O emissions of the n^{th} project campaign (tN_2O or kgN_2O)
NAP_n	Campaign length of the n^{th} project campaign ($tHNO_3$)

Before calculation of the Project Emissions (PE) the same statistical analysis as for the calculation of the baseline emission factor (EF_{BL}) is applied to the monitoring raw data (hourly average values) of each project campaign.

The respective correction functions for NCSG and VSG as determined during the relevant QAL2 test are applied within the calculation.

Analysis of Project campaign data

The following table shows the number of data sets and the respective amount of NAP during the campaigns included in this monitoring period:

Campaign	Data sets	NAP (in $tHNO_3$)
PC16	1,886	21,351
PC17	1,776	21,921
PC18	1,714	20,874
PC19	1,896	19,264
PC20	1,547	16,429
PC21	2,723	20,484
PC22	2,166	16,130

Incomplete and implausible monitoring data sets have been eliminated. The following exclusion criteria according to plant operation trip values were applied; all datasets recorded during times when the plant was not in operation are excluded:

Limits for definition of plant operation (trip)	
OTh	> 550 °C
OPh	< 1500 kPa
AIFR	< 0.081

The remaining number of datasets is the number of operating hours. The table below shows the operating hours for each campaign included in this monitoring period:

Campaign	Operating hours (OH)
PC16	1,785
PC17	1,731
PC18	1,667
PC19	1,592
PC20	1,319
PC21	1,628
PC22	1,312

By applying the 95% confidence interval on the remaining NCSG and VSG values mavericks and outliers are excluded. The 95% confidence interval for NCSG and VSG values is derived and the outliers excluded individually for VSG and NCSG. Hence, the remaining number of data sets may differ between NCSG and VSG. The resulting mean values for NCSG and VSG are applied for calculation of the Project emissions (PE).

Relevant Project Emissions (PE_n) and respective Project Emission Factors (EF_n)

The resulting values for $NCSG_n$, VSG_n, OH_n, NAP_n, project emissions (PE_n) and project emission factor (EF_n) for the project campaigns covered by this monitoring report are:

		Project Campaign 16 (PC16); 08/11/2011 - 26/01/2012	Project Campaign 17 (PC17); 27/01/2012 - 09/04/2012	Project Campaign 18 (PC18); 10/04/2012 - 20/06/2012	Project Campaign 19 (PC19); 21/06/2012 - 07/09/2012
$NCSG_n$	mg/Nm³	1,656	1,207	1,175	1,183
$QAL2_{\_NCSG}$		*applied to raw data*	*applied to raw data*	*applied to raw data*	*applied to raw data*
VSG_n	Nm³/h	47,226	47,029	46,506	45,680
$QAL2_{\_VSG}$		*applied to raw data*	*applied to raw data*	*applied to raw data*	*applied to raw data*
OH_n	h	1,785	1,731	1,667	1,592
NAP_n	t HNO_3	21,351	21,921	20,874	19,264
$NAP_{n\ (2012)}$	t HNO_3	21,351	21,921	20,874	19,264
$NAP_{n(2013)}$	t HNO_3				
EF_n	kg N_2O/t HNO_3	6.54	4.48	4.37	4.47

		Project Campaign 20 (PC20); 08/09/2012 - 11/11/2012	Project Campaign 21 (PC21); 12/11/2012 - 05/03/2013	Project Campaign 22 (PC22); 06/03/2013 - 04/06/2013
$NCSG_n$	mg/Nm³	1,553	1,506	1,775
$QAL2_{\_NCSG}$		*applied to raw data*	*applied to raw data*	*applied to raw data*
VSG_n	Nm³/h	47,475	46,628	45,739
$QAL2_{\_VSG}$		*applied to raw data*	*applied to raw data*	*applied to raw data*
OH_n	h	1,319	1,628	1,312
NAP_n	t HNO_3	16,429	20,484	16,130
$NAP_{n\ (2012)}$	t HNO_3	16,429	8,110	
$NAP_{n(2013)}$	t HNO_3		12,374	16,130
EF_n	kg N_2O/t HNO_3	5.92	5.58	6.60

Please refer to the submitted excel calculation spread sheet for further detail of the calculation.

Project Campaign Length

If the length of each individual project campaign CL_n is longer than or equal to the average historic campaign length CL_{normal} or to the baseline campaign length whichever is shorter, then all N_2O values measured during the baseline campaign can be used for the calculation of EF (subject to the elimination of data from the operational limits analysis, see above under recalculation of Baseline Emission factor).

Sample calculation for the project campaigns

Sample calculation for campaign emissions (PE) and Emission factor (EF_n) for the 16th project campaign:											
PE [tN_2O] =	47,226 [Nm³/h]	*	1,656 [mg/Nm³]	*	1,785 [h]	*	10^{-9} =	**139.6 [tN2O]**			

EF [kgN2O/tHNO3] =	139.6 [tN2O]	/	21,351 [tHNO3]	*	10^3 =	**6.54 [kgN2O/tHNO3]**		

Sample calculation for campaign emissions (PE) and Emission factor (EF_n) for the 17th project campaign:								
PE [tN_2O] =	47,029 [Nm³/h]	*	1,207 [mg/Nm³]	*	1,731 [h]	*	10^{-9} =	**98.2 [tN2O]**
EF [kgN2O/tHNO3] =	98.2 [tN2O]	/	21,921 [tHNO3]	*	10^3 =	**4.48 [kgN2O/tHNO3]**		

Sample calculation for campaign emissions (PE) and Emission factor (EF_n) for the 18th project campaign:								
PE [tN_2O] =	46,506 [Nm³/h]	*	1,175 [mg/Nm³]	*	1,667 [h]	*	10^{-9} =	**91.1 [tN2O]**
EF [kgN2O/tHNO3] =	91.1 [tN2O]	/	20,874 [tHNO3]	*	10^3 =	**4.37 [kgN2O/tHNO3]**		

Sample calculation for campaign emissions (PE) and Emission factor (EF_n) for the 19th project campaign:								
PE [tN_2O] =	45,680 [Nm³/h]	*	1,183 [mg/Nm³]	*	1,592 [h]	*	10^{-9} =	**86.0 [tN2O]**
EF [kgN2O/tHNO3] =	86.0 [tN2O]	/	19,264 [tHNO3]	*	10^3 =	**4.47 [kgN2O/tHNO3]**		

Sample calculation for campaign emissions (PE) and Emission factor (EF_n) for the 20th project campaign:								
PE [tN_2O] =	47,475 [Nm³/h]	*	1,553 [mg/Nm³]	*	1,319 [h]	*	10^{-9} =	**97.3 [tN2O]**
EF [kgN2O/tHNO3] =	97.3 [tN2O]	/	16,429 [tHNO3]	*	10^3 =	**5.92 [kgN2O/tHNO3]**		

Sample calculation for campaign emissions (PE) and Emission factor (EF_n) for the 21th project campaign:								
PE [tN_2O] =	46,628 [Nm³/h]	*	1,506 [mg/Nm³]	*	1,628 [h]	*	10^{-9} =	**114.3 [tN2O]**
EF [kgN2O/tHNO3] =	114.3 [tN2O]	/	20,484 [tHNO3]	*	10^3 =	**5.58 [kgN2O/tHNO3]**		

Sample calculation for campaign emissions (PE) and Emission factor (EF_n) for the 22th project campaign:								
PE [tN_2O] =	45,739 [Nm³/h]	*	1,775 [mg/Nm³]	*	1,312 [h]	*	10^{-9} =	**106.5 [tN2O]**
EF [kgN2O/tHNO3] =	106.5 [tN2O]	/	16,130 [tHNO3]	*	10^3 =	**6.60 [kgN2O/tHNO3]**		

Note that small deviations occur due to rounding. The figures stated here reflect the correct values as of the excel calculation. Please refer to the calculation excel file for details.

E.3. Calculation of leakage

>>
No leakage occurs under this project type.

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

A ***moving average emissions factor*** must be calculated at the end of a campaign n as follows:

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

This process is repeated for each campaign such that a moving average, $EF_{ma,n}$, is established over time, becoming more representative and precise with each additional campaign.

To calculate the total emission reductions achieved in a campaign according to the formula below, the higher of the two values $EF_{ma,n}$ and EF_n shall be applied as the emission factor relevant for the particular campaign to be used to calculate emissions reduction s (EF_p). Thus:

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

In addition a campaign-specific ***minimum emissions factor*** (EF_{min}) shall be used to cap any potential long-term trend towards decreasing N_2O emissions that may result from a potential built up of platinum deposits. After the first ten campaigns of the crediting period of the project, the lowest EF_n observed during those campaigns will be adopted as a minimum emission factor

(EF_{min}). If any of the later project campaigns results in 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. As the project campaigns of this current monitoring period includes only the 9th project campaign consideration of EF_{min} is not yet of relevance.

The emission reductions for the project activity during this monitoring period are determined by deducting the campaign-specific emission factor from the baseline emission factor and multiplying the result by the production output of 100% concentrated nitric acid over the campaign period and the GWP of N_2O according to:

$ER = (EF_{BL} – EF_P) * NAP * 10^{-3} * GWP_{N2O}$ (tCO_2e)

Sample calculation of emission reductions:

PC16: ER [tCO_2e] =		(10.631	-	6.540)	[kg N_2O/t HNO_3]	*	21,351	[t HNO_3]	*	10^{-3}	*	310	=	**27,077**	**[tCO2e]**
PC17: ER [tCO_2e] =		(10.631	-	4.695)	[kg N_2O/t HNO_3]	*	21,921	[t HNO_3]	*	10^{-3}	*	310	=	**40,336**	**[tCO2e]**
PC18: ER [tCO_2e] =		(10.631	-	4.677)	[kg N_2O/t HNO_3]	*	20,874	[t HNO_3]	*	10^{-3}	*	310	=	**38,528**	**[tCO2e]**
PC19: ER [tCO_2e] =		(10.631	-	4.666)	[kg N_2O/t HNO_3]	*	19,264	[t HNO_3]	*	10^{-3}	*	310	=	**35,622**	**[tCO2e]**
PC20: ER [tCO_2e] =		(10.519	-	5.921)	[kg N_2O/t HNO_3]	*	16,429	[t HNO_3]	*	10^{-3}	*	310	=	**23,418**	**[tCO2e]**
PC21 2012: ER [tCO_2e] =		(10.631	-	5.580)	[kg N_2O/t HNO_3]	*	8,110	[t HNO_3]	*	10^{-3}	*	310	=	**12,698**	**[tCO2e]**
PC21 2013: ER [tCO_2e] =		(10.631	-	5.580)	[kg N_2O/t HNO_3]	*	12,374	[t HNO_3]	*	10^{-3}	*	298	=	**18,624**	**[tCO2e]**
PC22: ER [tCO_2e] =		(10.515	-	6.603)	[kg N_2O/t HNO_3]	*	16,130	[t HNO_3]	*	10^{-3}	*	298	=	**18,804**	**[tCO2e]**

Note that small deviations occur due to rounding. The figures stated here reflect the correct values as of the excel calculation. Please refer to the calculation excel file for details. The final result is rounded down.

Where:

Variable	Definition
ER	Emission reductions of the project for the specific campaign (tCO_2e)
NAP	Nitric acid production for the project campaign ($tHNO_3$). The maximum value of NAP shall not exceed the design capacity.
EF_{BL}	Baseline emissions factor ($kgN_2O/tHNO_3$)
EF_p	Emissions factor used to calculate the emissions from this particular campaign (i.e. the higher of $EF_{ma,n}$ and EF_n) ($kgN_2O/tHNO_3$)
GWP_{N2O}	Global Warming Potential of N_2O (tCO_2e/tN_2O)

The resulting emission reductions (ER) for each of the project campaigns covered by this monitoring report and all relevant monitoring results are summarized in the table below:

		Project Campaign 16 (PC16); 08/11/2011 - 26/01/2012	Project Campaign 17 (PC17); 27/01/2012 - 09/04/2012	Project Campaign 18 (PC18); 10/04/2012 - 20/06/2012	Project Campaign 19 (PC19); 21/06/2012 - 07/09/2012	Project Campaign 20 (PC20); 08/09/2012 - 11/11/2012	Project Campaign 21 (PC21); 12/11/2012 - 05/03/2013	Project Campaign 22 (PC22); 06/03/2013 - 04/06/2013
$NCSG_{BL}$	mg/Nm³	3,282	3,282	3,282	3,282	3,248	3,282	3,247
$QAL2_{\_NCSG}$		0.945	0.945	0.945	0.945	0.945	0.945	0.945
VSG_{BL}	Nm³/h	41,585	41,585	41,585	41,585	41,585	41,585	41,585
$QAL2_{\_VSG}$		1.096	1.096	1.096	1.096	1.096	1.096	1.096
OH_{BL}	h	1,506	1,506	1,506	1,506	1,506	1,506	1,506
NAP_{BL}	t HNO_3	19,027	19,027	19,027	19,027	19,027	19,027	19,027
BE	t N_2O	212.9	212.9	212.9	212.9	210.7	212.9	210.6
UNC		5.00	5.00	5.00	5.00	5.00	5.00	5.00
EF_{BL}	**kg N_2O/t HNO_3**	**10.63**	**10.63**	**10.63**	**10.63**	**10.52**	**10.63**	**10.51**
$NCSG_n$	mg/Nm³	1,656	1,207	1,175	1,183	1,553	1,506	1,775
$QAL2_{\_NCSG}$		*applied to raw data*	*applied to raw data*	*applied to raw data*	*applied to raw data*	*applied to raw data*	*applied to raw data*	*applied to raw data*
VSG_n	Nm³/h	47,226	47,029	46,506	45,680	47,475	46,628	45,739
$QAL2_{\_VSG}$		*applied to raw data*	*applied to raw data*	*applied to raw data*	*applied to raw data*	*applied to raw data*	*applied to raw data*	*applied to raw data*
OH_n	h	1,785	1,731	1,667	1,592	1,319	1,628	1,312
NAP_n	t HNO_3	21,351	21,921	20,874	19,264	16,429	20,484	16,130
$NAP_{n\ (2012)}$	t HNO_3	21,351	21,921	20,874	19,264	16,429	8,110	
$NAP_{n(2013)}$	t HNO_3						12,374	16,130
PE_n	t N_2O	139.6	98.2	91.1	86.0	97.3	114.3	106.5
EF_n	kg N_2O/t HNO_3	6.54	4.48	4.37	4.47	5.92	5.58	6.60
$EF_{ma,n}$	kg N_2O/t HNO_3	4.71	4.70	4.68	4.67	4.73	4.77	4.85
EF_{min}	kg N_2O/t HNO_3	2.98	2.98	2.98	2.98	2.98	2.98	2.98
EF_p	**kg N_2O/t HNO_3**	**6.54**	**4.70**	**4.68**	**4.67**	**5.92**	**5.58**	**6.60**
GWP_{2012}	tCO_2e/tN_2O	310	310	310	310	310	310	
GWP_{2013}	tCO_2e/tN_2O						298	298
ER_{2012}	**tCO_2e**	**27,077**	**40,336**	**38,528**	**35,622**	**23,418**	**12,698**	
ER_{2013}	**tCO_2e**						**18,624**	**18,804**
Total until 31/12/2012	**tCO_2e**	**177,679**						
Total from 01/01/2013	**tCO_2e**	**37,428**						
Total ER for the monitoring period		**215,107**						

Item	Baseline emissions or baseline net GHG removals by sinks	Project emissions or actual net GHG removals by sinks	Leakage	Emission reductions or net anthropogenic GHG removals by sinks
	(t CO_2e)	(t CO_2e)	(t CO_2e)	(t CO_2e)
PC16	70,364	43,286	0	27,077
PC17	72,243	31,906	0	40,336
PC18	68,791	30,263	0	38,528
PC19	63,485	27,862	0	35,622
PC20	53,575	30,156	0	23,418
PC21	65,927	34,604	0	31,322
PC22	50,543	31,738	0	18,804
Total	444,927	229,815	0	215,107

Note that small deviations might occur due to rounding. The figures stated here reflect the correct values as of the excel calculation. Please refer to the calculation excel file for details. The final result for each campaign is rounded down.

AM0034 requires calculating emission reductions by establishing product related baseline and project emission factors and multiplying the difference with the nitric acid production. The baseline emissions and the project emissions stated in the summary of calculations have been calculated only for the purpose of this table. The calculations are not in line with the methodology.

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

The design capacity of the plant is 300 metric tonnes per day, operating 365 days per year. This equals a total production of 172,500 tonnes for a period of 575 days. Therefore the factual production of 136,453 tonnes during this monitoring period is lower than the design capacity of the plant.

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	379,180 (calculated for a monitoring period of 575 days)	215,107 (calculated for a monitoring period of 504 days)

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

>>

Not applicable as the actual GHG emission reductions achieved during this monitoring period are below the values estimated in ex-ante calculation of the registered PDD.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO_2e)	177,679	37,428

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Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	**X** Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	Dongbu
Street/P.O. Box	
Building	
City	
State/Region	
Postcode	
Country	
Telephone	
Fax	
E-mail	
Website	
Contact person	
Title	
Salutation	
Last name	
Middle name	
First name	
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	**X** Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	JM
Street/P.O. Box	
Building	
City	
State/Region	
Postcode	
Country	
Telephone	
Fax	
E-mail	
Website	
Contact person	
Title	
Salutation	
Last name	

Middle name	
First name	
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	**X** Project participant ☐ Responsible person/ entity for completing the CDM-MR-FORM
Organization name	UPC
Street/P.O. Box	
Building	
City	
State/Region	
Postcode	
Country	
Telephone	
Fax	
E-mail	
Website	
Contact person	
Title	
Salutation	
Last name	
Middle name	
First name	
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Project participant and/or responsible person/ entity	**X** Project participant **X** Responsible person/ entity for completing the CDM-MR-FORM
Organization name	N.serve Environmental Services GmbH
Street/P.O. Box	Grosse Theaterstr. 14
Building	-
City	Hamburg
State/Region	Hamburg
Postcode	20354
Country	Germany
Telephone	+494030997860
Fax	+4940309978610
E-mail	contact@nserve.net
Website	www.nserve.net

Contact person	Nikolaus Gutknecht-Stöhr
Title	Head of Portfolio Manager
Salutation	Mr
Last name	Gutknecht-Stöhr
Middle name	
First name	Nikolaus
Department	Portfoliomanagement
Mobile	+49163 314 2825
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Document information

Version	*Date*	*Description*
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	28 May 2010	EB 54, Annex 34. Initial adoption.

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