MONITORING REPORT FORM (F-CDM-MR)
Version 02.0

MONITORING REPORT

Title of the project activity	Fatima N_2O Abatement Project
Reference number of the project activity	5461
Version number of the monitoring report	01
Completion date of the monitoring report	10/08/2012
Registration date of the project activity	01/04/2012
Monitoring period number and duration of this monitoring period	**Monitoring period No. 1** 01/04/2012 – 31/07/2012 Duration (days): 122
Project participant(s)	• Fatima Fertilizer Company Limited (“Fatima”) • N.serve Environmental Services GmbH (“N.serve”)
Host Party(ies)	Islamic Republic of Pakistan
Sectoral scope(s) and applied methodology(ies)	• Sectoral scope: 05 • Applied methodology: ACM0019 v.01.0.0.
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	192,445
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	164,738

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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(a)

The aim of the project activity is to reduce nitrous oxide (N_2O) emissions in the tail gas of the nitric acid plant of Fatima Fertilizer Company Ltd., Pakistan (hereafter: “Fatima”), which would normally be released to the atmosphere. N_2O is an undesired by-product in the production process of nitric acid, which was normally released to the atmosphere, as no abatement N_2O-abatement system was foreseen in the original plant design. Therefore, the original plant (which did not foresee any N_2O- abatement system) has been equipped with a tertiary N_2O abatement unit in the tail gas stream right after the absorption tower.

(b)

The tertiary N_2O abatement technology is installed downstream of the HNO_3 absorber and before the tail gas turbine. The tertiary system has been design and constructed by Uhde. A tertiary catalyst reduces N_2O that is formed in the primary ammonia oxidation reaction. In the tertiary abatement system N_2O is removed by a catalytic reduction with a hydro carbon, such as natural gas. Within the De-N_2O catalyst layer the decomposition of N_2O is carried out at full load of NO_x, because the NO_x additionally promotes the decomposition of N_2O. The applied technology is chosen because it has negligible risk to decrease HNO_3 production and a high expected N_2O decomposition rate of around 98% of the N_2O.

(c)

Relevant dates for the project activity:

Date	Event
12/2006	Relocation of nitric acid plant to Pakistan
26/10/2007	Project activity start date
04/2010	Commissioning of the nitric acid plant in Pakistan
20/09/2006 – 02/05/2011	Real and continuous actions to develop an emission reduction project under AM0028.
01/12/2011	Commissioning of the ENVINOx unit in Fatima’s nitric acid plant
01/04/2012	Registration of the Project Activity at the UNFCCC
01/04/2012	Start of Crediting Period

(d)

Total GHG emission reductions achieved in this monitoring period: 164,738.

A.2. Location of project activity

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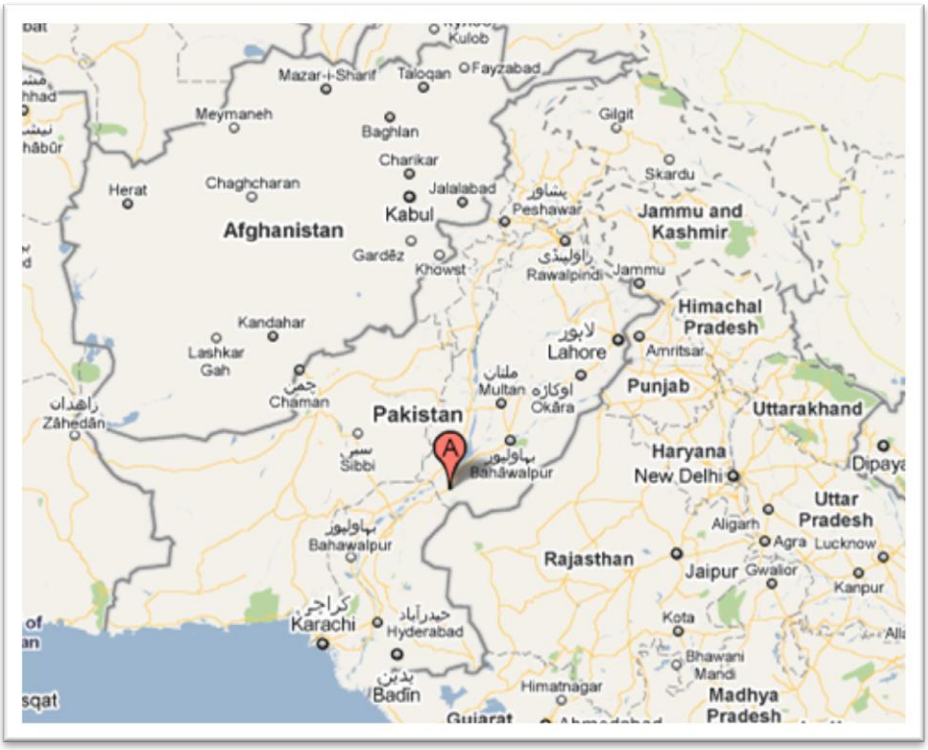
(a) Host Party: Islamic Republic of Pakistan

(b) Region/State/Province: Sadiqabad/District Rahim Yar Khan/Punjab

(c) United Sugar Mill Road, Mukhtar Garh, Sadiqabad

(d) Physical/ Geographical location: The Fatima Fertilizer complex is located at latitude of approximately N 28°15.749’ and a longitude of E 70° 1.895’.



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)
Pakistan (host)	**Fatima Fertilizer Company Limited (“Fatima”)** [owner and operator of the nitric acid plant]	No
United Kingdom of Great Britain and Northern Ireland	**N.serve Environmental Services GmbH (“N.serve”)** [Project developer] **Fatima Fertilizer Company Limited (“Fatima”)** [owner and operator of the nitric acid plant]	No

A.4. Reference of applied methodology

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(a) Applied methodology: ACM0019 Version 01.0.0: “N_2O abatement from nitric acid production”

(b) Applied tools:

i. “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion” (Version 02)

ii. “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0)

A.5. Crediting period of project activity

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(a) Type of Crediting Period: Non-renewable 10 years and 0 month

(b) Start date of Crediting Period: 01/04/2012

(c) Start of this Monitoring Period: 01/04/2012

(d) End date of this Monitoring Period: 31/07/2012

(e) Length of this Monitoring Period: 122 days

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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(a)

The N_2O abatement system consists of a tertiary N_2O catalyst unit, which is installed downstream of the HNO_3 absorber and before the tail gas turbine. It was designed and constructed by Uhde. The tertiary catalyst consists of an additional catalysts containment facility that was erected at the plant. It is filled with a pelleted catalyst and utilizes a hydro - carbon, such as natural gas, to reduce the N_2O formed in the primary ammonia oxidation reaction. A wide range of metals (e.g. Cu, Fe, Mn, Co and Ni) have shown to be of varied efficiency in N_2O abatement. Within the De-N_2O catalyst layer the decomposition of N_2O is carried out at full load of NO_x, because the NO_x additionally promotes the decomposition of N_2O.

The technology has negligible impact on the HNO_3 production and is guaranteed to have a minimum abatement efficiency of 94%, an expected abatement efficiency of around 98% and a factual abatement efficiency of more than 99% of N_2O.

The tertiary abatement system to be implemented and the Fatima Nitric Acid Plant comprise the following technical core details:

Design parameter	
Plant capacity	1,500 t 100%HNO_3/day plant load
Tail gas flow	193,000 Nm^3/h
Temperature	440°C
Pressure	9.5 bars
Natural gas consumption	0.45 mol CH_4/ 1 mol N_2O
Operating conditions	
Min.Reactor inlet temperature	415 °C
Max. Reactor inlet temperature	450°C
Tailgas flow rate to reactor	200,000 Nm^3/h
Max. Inlet N_2O concentration	2,000 ppm
Abatement efficiency	
Expected abatement efficiency	98 %
Guaranteed abatement efficiency	94 %

Figure 1 below depicts the flow system of the tertiary catalyst unit:

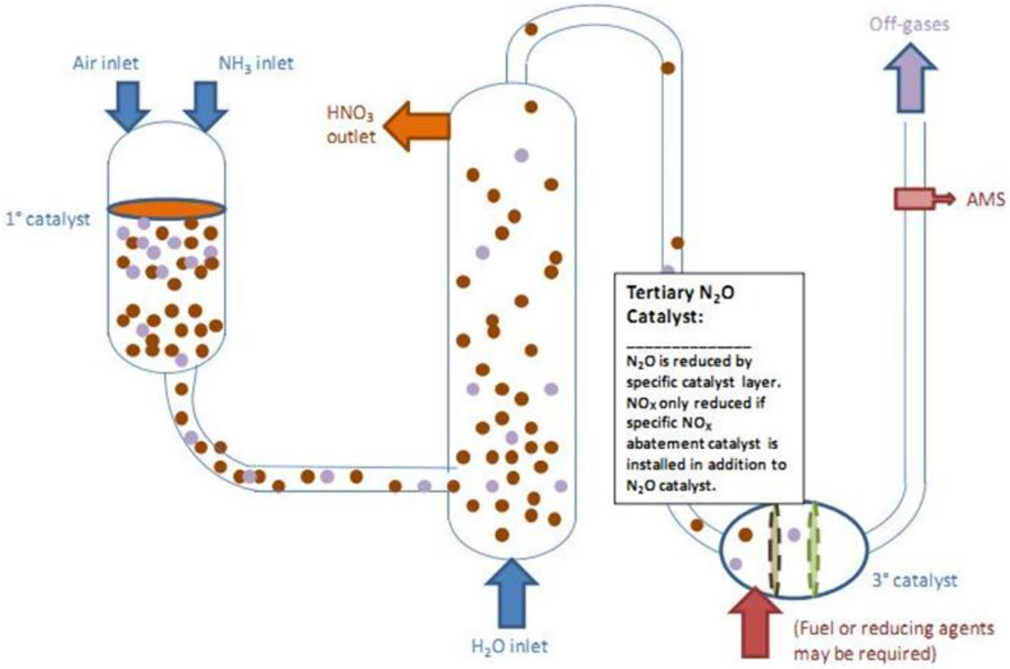

Figure 1: Image flow of tertiary catalyst unit

Production related events or situations that occurred during the monitoring period

As to the characteristics of this specific project type certain production related events and incidents may affect the performance of the project or influence the monitoring of emission reductions in addition to possible failure of the installed monitoring equipment. The below table and lists demonstrate all relevant events and incidents related to production and/or emission monitoring which have occurred during actual operation within this specific monitoring period, as well as the measures taken for addressing any resulting problems and issues.

From	To	Event	Explanation/Action
17:16:02 hrs - 31March 2012	00:00:01 hrs - 2April 2012	Safe Shutdown of NA Plant	Due to sufficient Inventory of NA in Storage tank,NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped) to conserve Ammonia due to shutdown of Ammonia Plant
17:09:39 hrs - 31March 2012	02:05:29 hrs - 2April 2012	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped to conserve Ammonia
17:07:06 hrs - 31March 2012	02:30:51 hrs - 2April 2012	EnviNOX stopped/NG supply cut off due to NA Plant stoppage.	NA Plant stopped to conserve Ammonia
04:18:44 hrs - 19 April 2012	15:31:48 hrs - 20 April 2012	Safe Shutdown of NA Plant	Due to sufficient Inventory of NA in Storage tank,NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped) to conserve Ammonia due to shutdown of Ammonia Plant
04:18:44 hrs - 19 April 2012	16:00:54 hrs - 20 April 2012	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped to conserve Ammonia

03:54:19 hrs - 19 April 2012	16:18:09 hrs - 20 April 2012	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant S/D planned to conserve Ammonia
04:08:17 hrs - 27 April 2012	09:02:32 hrs - 27 April 2012	Safe Shutdown of NA Plant	Safe shut down due to leakage in gasket of H-107B Cooler condenser inspection flange,NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped) for replacement of gasket
04:08:17 hrs - 27 April 2012	09:37:10 hrs - 27 April 2012	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped due to leakage in gasket of H-107B Cooler condenser inspection flange
03:58:26 hrs - 27 April 2012	09:50:25 hrs - 27 April 2012	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped due to leakage in gasket of H-107B Cooler condenser inspection flange
23/05/12 00:52	24/05/12 07:02	Safe Shutdown of NA Plant	Safe shut down due to acid treatment of NA Plant catalyst,NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped) for acid cleaning of Pt/Rh/Pd Catalyst
23/05/12 00:52	24/05/12 08:10	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped for acid cleaning of Pt/Rh/Pd Catalyst
23/05/12 00:49	24/05/12 08:23	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped for acid cleaning of Pt/Rh/Pd Catalyst
11.07.12 00:09	**16.07.12 01:30**	Safe Shutdown of NA Plant	Due to sufficient Inventory of NA in Storage tank,NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped) to carry out planned jobs,Surface condenser cleaning & Replacement of Boiler feed water motor.
11.07.12 00:09	**16.07.12 02:25**	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped due to planned shutdown
11.07.12 00:00	**16.07.12 02:38**	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped due to planned shutdown

Table 1: Production related events during Monitoring Period

(b)

Date	Event
12/2006	Relocation of nitric acid plant to Pakistan
26/10/2007	Project activity start date
04/2010	Commissioning of the nitric acid plant in Pakistan
01/12/2011	Commissioning of the ENVINOx unit in Fatima's nitric acid plant
01/04/2012	Submission of Request for Registration to the UNFCCC
01/04/2012	Start of this Monitoring Period
31/07/2012	End of this Monitoring Period

Table 2: Implementation schedule of the project activity

(c) Description of:

i. Events or situations that may have impacted the applicability of the applied methodology: No.
ii. The following describes how these events or situations have been addressed: Not applicable.

B.2. Post registration changes

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

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Have there been any temporary deviations from the Monitoring plan during this monitoring period?

No.

B.2.2. Corrections

>>

Are there any corrections to project information or parameters fixed at validation approved during this monitoring period or submitted in this monitoring report?

No.

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

>>

No.

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

>>

No.

B.2.5. Changes to start date of crediting period

>>

No.

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

>>

Not applicable.

SECTION C. Description of monitoring system

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Installed Measurement Equipment

The following figure depicts the nitric acid plant including the tertiary abatement technology and all relevant installed meters. For specifications and details on the equipment, please see the respective information in the parameter tables of section D.2

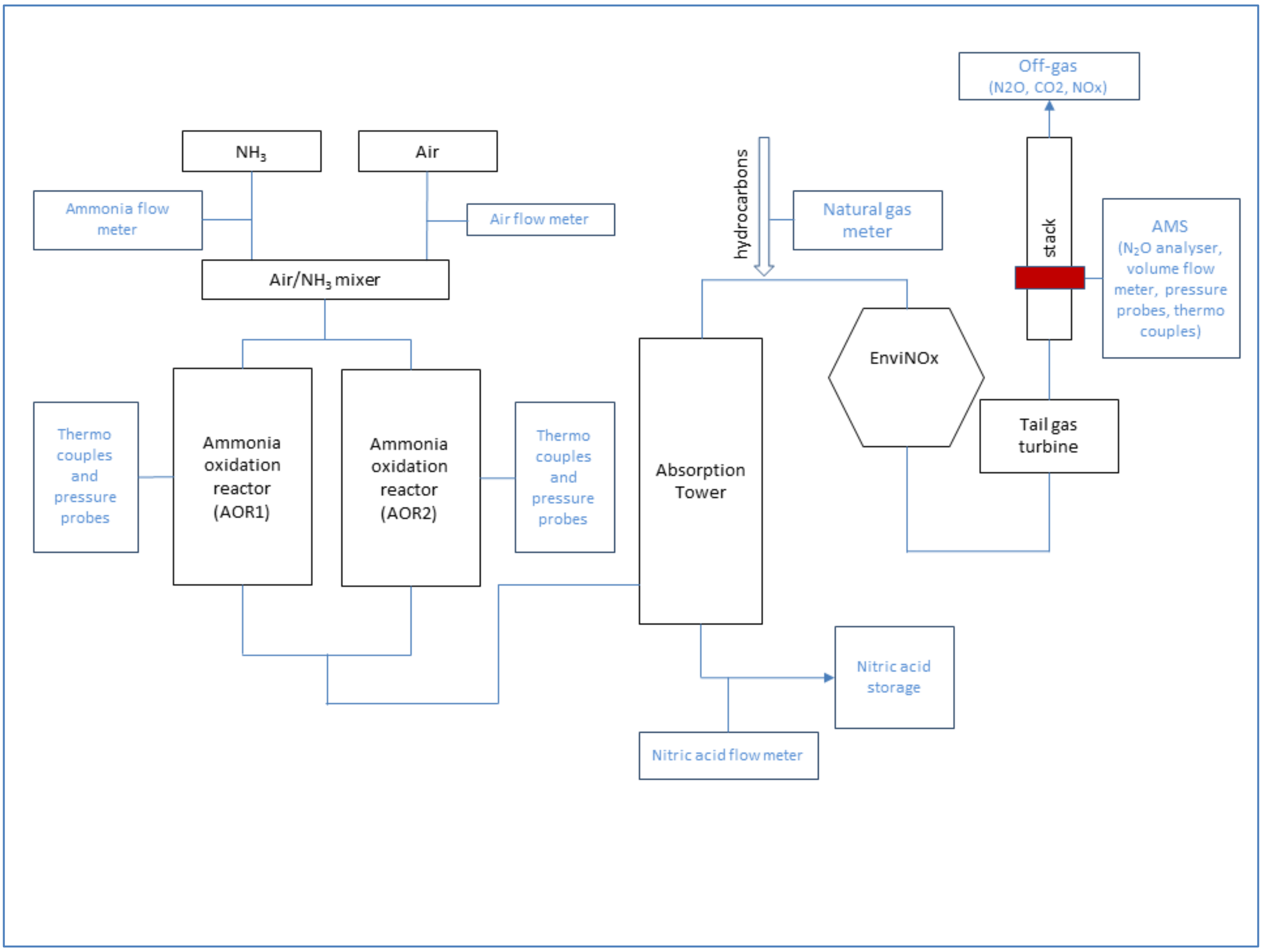

Figure 2: line diagram of nitric acid plant with tertiary abatement technology and positioning of Measurement equipment

Sample points

The sample points were chosen in accordance with the AMS requirements, EN 14181 requirements and the plant design specifications to allow an optimum of data collecting quality.

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 graph above shows the location of the sample point schematically.

Analyzer

The ABB EL3020 URAS 26 is capable of analyzing N_2O concentration in gas mixtures. The continuous NDIR industrial photometer can selectively measure concentrations of up to four sample components. In this case it is equipped for the measurement of N_2O and NO. The analyzer features gas-filled opto-pneumatic detectors. The detector provides optimum sensitivity and high selectivity compared with the other gas components in the sample. Gas-filled calibration cells are used for automatic calibration. The Analyzer is QAL1 tested for the measurement of N_2O.

Sample Conditioning System

The gas sample is extracted at the sampling point particles are removed with a heated filter unit and the clean sampling gas is delivered through a heated sampling line to the analyzer cabinet. Before being fed to the analyzer, moisture is removed by a sample conditioning system that is installed in the analyzer cabinet. This gas cooler unit maintains a constant dew point of the sample gas of 3 °C and efficiently separates the moisture from the sampling gas. The minimum flow rate to the analyzer is controlled and connected to an alarm. In case of moisture break through due to a failure of the cooler the sampling pump will be stopped automatically and an alarm is given to the data control system.

Stack gas flow meter

The D-FL 100 measuring system operates according to the differential pressure principle. The probe has two separate chambers, between which the flow builds up a differential pressure. Taking into account the other flow parameters such as, e.g. absolute pressure and temperature, the volume flow is converted from operating to standard conditions with the help of the D-FL 100-10 microprocessor evaluation unit.

The D-FL 100 is type tested to the guidelines of the German Federal Ministry for the Environment, Nature Conservation and Reactor Safety on suitability testing of measuring equipment for continuous measuring of emissions and is therefore officially QAL1 approved (see below).

Accuracy and Calibration of Instruments

All meters are maintained to ensure a high level of accuracy. The exact specifications of each meter have been included in procedures to maintain those levels of accuracy. These procedures can be found for each parameter in section D.2.

ACM0019 requires all key meters to be subject to a quality control regime that will include regular maintenance and calibration according to the European Norm EN 14181. A record is being maintained showing the location and unique identification number of each meter, the calibration status of that meter (when last calibrated, when next due for calibration).

In the following, it is described how the procedures given in EN 14181 for QAL1-3 have been applied at the plant.

QAL1

In accordance with EN 14181, the monitoring system for N_2O concentration measurements 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 15267 or equivalent standards. This standard's objective is to prove 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.

ABB EL 3020 Uras 26: Tüv Süd Industrie Service GmbH, Certification Number 1669640-ts[1]

Durag D-FL 100: Tüv Rheinland Immissionsschutz und Energiesysteme GmbH, Test Report: 128 CU11650 Tüv Nord 1996-03-29[2]

QAL2

QAL2 is a procedure for the determination of the calibration function and its variability. According to EN 14181, the QAL2 test including the SRM need to be conducted by an independent testing house or laboratory which has to be accredited to EN ISO/IEC 17025. 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).

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 by the independent qualified "testing house".

QAL2 tests are to be performed at least every 5 years according to EN 14181.

Details on QAL2-tests can be found in the parameter section within D.2.

AST

In addition, Annual Surveillance Tests (AST) should be conducted in accordance with EN 14181; these are a series of measurements with independent measurement equipment in parallel to the existing AMS. The AST tests are performed annually. If a full QAL2 test is performed (at least every 5 years), an additional AST test is not necessary in that same year.

Details on AST-tests can be found in the parameter section within D.2.

QAL3

QAL3 describes the ongoing quality assurance and maintenance procedures and documentation for the AMS conducted by the plant operator. With this documentation it can be demonstrated that the AMS is in control during its operation so that it continues to function within the required specifications.

In essence, staff performs QAL3 procedures through the established calibration procedures as outlined for the applicable parameter in section D.2.

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[1] Download: http://www.qal1.de/15267/1669640ts_00_abb_EL3000_de.pdf.
[2] Download: http://qal1-cert.eu/data/QAL1_durag_d-fl100_en.pdf.

N_2O-Analyser Zero Calibration

Conditioned ambient air is used as reference gas for zero calibration. The zero calibration is conducted automatically every 24 hours.

N_2O-Analyser Span calibration

For automatic span calibrations the URAS 26 Analyser is equipped with a "Calibration Cuvette" (gas filled adjustment cells), which is installed as part of the analyser. The Automatic calibration is done after every second automatic zero point calibration. Manual calibration checks are done with certified calibration gas at least every 2 weeks. The calibration results and subsequent actions are all documented as part of the CDM procedure. In addition, the analyser room and equipment is visually inspected on a regular basis.

Flow meter calibration procedures

The flow meter itself does not need to be calibrated since it is a physical device which will not have drift. Therefore, it is sufficient to regularly inspect its physical condition by means of visual and electric checks of the probe. It shall be cleaned if deemed necessary. In addition the flow meter is checked during the QAL2 and AST tests by an independent laboratory by comparison to a standard reference method (SRM) as stated above.

Organization Structure with Management & Operation Process

As an operator of nitric acid plants since many years, the plant's staff in general and its instrument department in particular have been accustomed to operating technical equipment adhering to high quality standards.

Fatima has trained the staff selected for the operation of the relevant monitoring systems and ensures that the operational standards required for the appropriate handling of the equipment will be maintained throughout the crediting period. Measuring instruments will be calibrated by the instrumentation engineer in accordance with the requirements of the instrument suppliers. The operations and equipment engineers of the nitric acid plant are responsible for the daily operation and maintenance of the systems.

The monitoring of the parameters for the determination of the mass flow of the N_2O will be the responsibility of the monitoring department. All relevant data will be recorded automatically and stored on electronic media.

Data Processing

Archiving of data

The monitoring team archives data to a secure and retrievable storage format on a periodic basis. This step of data archiving can also be implemented as an automated routine within the data collection unit. Calibration records may be archived by scanning and storage in an accessible electronic format. These data will be stored until 2 years after the end of the crediting period or the last issuance of CERs whichever occur later.

Document Control

The Project Manager will implement a document control system that ensures that the current versions of necessary documents are available at the point of use. All documents must be maintained in English with local translations (if necessary) because English is the formal language of the CDM.

Preparation of monitoring report

The archived / live data will be used to prepare a periodic monitoring report to be submitted to the UNFCCC secretariat for verification and issuance of CERs. N.serve is responsible for the preparation of the monitoring report including the correct application of ACM0019 and the calculation of achieved emission reductions, subject to correct raw data submitted by the plant owner. An internal technical review process will be conducted and documented before such a report will be submitted for verification.

Data recording system

The CDM Project Manager will implement a data recording system for collection and archiving of the monitoring raw data. The data recording frequency for the continuously monitored parameters is 2 seconds. From these raw data hourly average values are calculated automatically.

Treatment of missing or corrupted data

If data for either the N_2O concentration the volume or mass flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N_2O concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the N_2O concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of N_2O calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut down shall not be used for the determination of the maximum values.

Similar provision may apply for the CH_4 inflow and the nitric acid produced. If data for the CH_4 inflow is not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of CH_4 inflow observed during the monitoring period. In case of missing hourly data for the nitric acid produced in the monitoring period *n* ($P_{NA,n}$) the value will be replaced by a nitric acid production value from another source of data e. g. measurements of nitric acid storage tank levels in combination with a production – consumption mass balance. Only in the case that there should be no other reliable data source available the missing value should be replaced with the lowest measured value during plant operations of that monitoring period. Values observed during five operating hours before and after a plant start-up and shut down shall not be used for the determination of the maximum and minimum values.

Audit function and management review

The Project Manager arranges for an internal audit of the management system once per year. The auditor will not be involved in the daily operation of the plant and if necessary, may be sourced from a third party. The auditor will assess the implementation of the monitoring procedure, quality assurance steps and data collection and archiving. Audit findings, and steps taken to address findings will be recorded and reviewed in a Management Review meeting (convened at least annually) at which time the effectiveness of these procedures will be reviewed and necessary changes implemented

SECTION D. Data and parameters

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

Data/Parameter	**$EF_{default,y}$**
Unit	$kgN_2O/tHNO_3$
Description	Default N_2O baseline emissions factor in the calendar year y of the monitoring period *n*
Source of data	ACM0019 Version 01.0.0
Value(s) applied	<table><tr><th>Year</th><th>Emissions factor ($kgN_2O/tHNO_3$)</th></tr><tr><td>2012</td><td>3.90</td></tr><tr><td>2013</td><td>3.70</td></tr><tr><td>2014</td><td>3.50</td></tr><tr><td>2015</td><td>3.40</td></tr><tr><td>2016</td><td>3.20</td></tr><tr><td>2017</td><td>3.00</td></tr><tr><td>2018</td><td>2.80</td></tr><tr><td>2019</td><td>2.70</td></tr><tr><td>2020</td><td>2.50</td></tr><tr><td>2021</td><td>2.50</td></tr><tr><td>Year n</td><td>2.50</td></tr></table>
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	The decrease in the value for the baseline emission factor over time is to reflect the technological development. Please note that the factual business-as-usual emissions are estimated to be 7.0 $kgN_2O/tHNO_3$.

Data/Parameter	GWP_{N2O}
Unit	tCO_2e/tN_2O
Description	Global warming potential of the nitrous oxide
Source of data	Relevant decisions by the CMP
Value(s) applied	310
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	-

Data/Parameter	R_u
Unit	$Pa.m^3/kmol.K$
Description	Universal ideal gases constant
Source of data	“Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0)
Value(s) applied	8,314
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	-

Data/Parameter	MM_i
Unit	kg/kmol
Description	Molecular mass of greenhouse gas *i* (N_2O)
Source of data	“Tool to determine the mass flow of a greenhouse gas in a gaseous stream” (Version 02.0.0)
Value(s) applied	44.02
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	-

Data/Parameter	**P_n**
Unit	Pa
Description	Total pressure at normal conditions
Source of data	"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0)
Value(s) applied	101,325
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	-

Data/Parameter	**T_n**
Unit	K
Description	Temperature at normal conditions
Source of data	"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0)
Value(s) applied	273.15
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	-

Data/Parameter	**$T_{open,n}$**
Unit	%
Description	Fraction of time in monitoring period *n* during which the by-pass valve on the line feeding the tertiary N_2O abatement facility was open to vent the gas directly to the atmosphere.
Source of data	ACM0019 v.01.0.0
Value(s) applied	0
Purpose of data	Calculation of baseline emissions or baseline net GHG removals by sinks
Additional comment	No by-pass is foreseen in the project design and therefore no by-pass valve will be installed from the beginning of the project activity. If necessary, plant will shut down.

D.2. Data and parameters monitored

Data/Parameter	**$P_{NA,n}$**
Unit	$tHNO_3$
Description	Nitric acid produced in the monitoring period *n*
Measured/Calculated /Default	Measured & calculated
Source of data	Volume of HNO_3 is continuously measured by a flow meter. Density & acid concentration are determined by laboratory analysis.
Value(s) of monitored parameter	**137,072**
Monitoring equipment	Magnetic flow meter IFC 100 Krohne manufactured by Krohne Germany Density & acid concentration are determined by laboratory analysis.
Measuring/Reading/ Recording frequency	HNO_3: continuously. Density & concentration analysis: 12 sample analyses per day are collected in one bottle, which is sent to the laboratory for analysis. From the result a daily average value is built.
Calculation method **(if applicable)**	Flow measurements (Nm^3/h) are multiplied with density - and concentration readings to determine the $P_{NA,n}$ mass flow in $tHNO_3/h$

<table>
<tr><td>QA/QC procedures</td><td>Maintenance and calibration of the flow meter and density meter has been applied under the internal QA/QC procedures implemented for this project activity.

Fatima prepares to acquire ISO9001 accreditation however at the time of writing this report the timeframe is not yet confirmed. All plant equipment and piping are designed as per ASME standards and their maintenance/QAQC is based on relevant API standards, vendor recommendations and prevailing practices in fertilizer industry.

TAG number/ model specification of meter: FIT 6291/ IFC 100 KROHNE
<table>
<tr><td>Overall measurement accuracy</td><td>+/- 0.5% of the adjusted range</td></tr>
<tr><td>Serial Number</td><td>A0830792</td></tr>
<tr><td>Calibration frequency</td><td>Once per 5 years</td></tr>
<tr><td>Date of last calibration</td><td>31/01/2012</td></tr>
<tr><td>Valid until</td><td>30/01/2017</td></tr>
</table>

DMA 4500 Density meter:
<table>
<tr><td>Overall measurement accuracy</td><td>0.000011g/cm3</td></tr>
<tr><td>Serial Number</td><td>80374589</td></tr>
<tr><td>Calibration frequency</td><td>Once per year</td></tr>
<tr><td>Date of last calibration</td><td>24/10/2011</td></tr>
<tr><td>Valid until</td><td>23/10/2012</td></tr>
</table></td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions or actual net GHG removals by sinks</td></tr>
<tr><td>Additional comment</td><td>Calibration according to plant internal procedure SOP No. 12</td></tr>
</table>

Data/Parameter	$F_{N2O, tailgas,h}$
Unit	kg N_2O/h
Description	Mass flow of N_2O in the gaseous stream of the tail gas in the hour *h*
Measured/Calculated /Default	Measured & calculated
Source of data	N_2O concentration: ABB EL3020 URAS 26 N_2O Analyzer Stack gas volume flow: Durag Annubar D-FL 100 flow meter
Value(s) of monitored parameter	Average value for this monitoring period: 0.36 Applied for the determination of $Q_{N2O,tailgas,n}$ and overall Project Emissions. See calculation sheet and sample calculation of section E.2.
Monitoring equipment	N_2O concentration: ABB EL3020 URAS 26 N_2O Analyzer Stack gas volume flow: Durag Annubar D-FL 100 flow meter
Measuring/Reading/ Recording frequency	Continuously

Calculation method (if applicable)	• The monitoring system should provide separate hourly average values for the N_2O concentration and the volume or mass flow of the tail gas based on 2 seconds (or shorter) interval readings that are recorded and stored electronically. These N_2O data sets shall be identified by means of a unique time / date key indicating when exactly the values were observed; • The correction factors derived from the calibration curve of the QAL2 audit for the monitoring components as determined during the QAL2-test in accordance with EN 14181 must be applied to both the N_2O concentration and the volume or mass flow of the tail gas. This can either be applied automatically to the raw data recorded by the data storage system at the plant or it can be applied to the calculated hourly averages as part of the calculation of project emissions. If data for either the N_2O concentration or the volume or mass flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N_2O concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the N_2O concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of N_2O calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut-down shall not be used for the determination of the maximum values. The hourly values are then aggregated as follows: (1) $Q_{N2O,tailgas,n} = \sum_{h=1}^{h=h_n} F_{N2O,tailgas,h} * 10^{-3}$ $Q_{N2O,tailgas,n}$ = Amount of N_2O released through the tail gas of the project plant to the atmosphere in monitoring period *n* (tN_2O) $F_{N2O,tailgas,h}$ = Mass flow of N_2O in the gaseous stream of the tail gas in the hour *h* (kgN_2O/h) h_n = Number of hours in monitoring period *n* during which the plant was in operation

<table>
<tr><td>QA/QC procedures</td><td>TAG number/ model specification of meter: AT-7640 / ABB EL3020 URAS 26 N_2O Analyzer
<table>
<tr><td>Measurement accuracy (for N_2O)</td><td>+/- 1% of the adjusted range</td></tr>
<tr><td>Serial Number</td><td>0241234806 / 1000</td></tr>
<tr><td>Calibration frequency</td><td>Annually by QAL2 /AST; Additional daily checks on operating conditions are performed as well as monthly calibration checks (with calibration gas cylinders)</td></tr>
<tr><td>Date of last calibration</td><td>QAL2
29/03/2012</td></tr>
<tr><td>valid until</td><td>28/03/2013 (next AST),
28/03/2017 (next QAL2)</td></tr>
</table>
Durag Annubar D-FL 100 flow meter
<table>
<tr><td>Measurement accuracy</td><td><0.9 m/s</td></tr>
<tr><td>Serial Number</td><td>1223310</td></tr>
<tr><td>Calibration frequency</td><td>Annually by QAL2 /AST; Additional daily checks on operating conditions are performed as well as monthly calibration checks (with calibration gas cylinders)</td></tr>
<tr><td>Date of last calibration</td><td>QAL2
27/03/2012 – 30/03/2010</td></tr>
<tr><td>valid until</td><td>26/03/2013 (next AST),
26/03/2017 (next QAL2)</td></tr>
</table>
QAL2 correction factors:
Analyzer: 0.97
Stack gas volume flow meter: 1.02</td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions or actual net GHG removals by sinks</td></tr>
</table>

Additional comment	According to EN 14181, the flow meter and the analyzer will be tested and calibrated by an external laboratory with EN ISO IEC 17025 Accreditation. The QAL2 test is conducted once every 3 years; the AST test is conducted once per year. Every 3 years the AST test is part of the QAL2 test. QAL2-3 calibration schedules are performed according to plant internal procedures: SOP No. 10 (analyzer) SOP No. 14 (stack gas flow meter)

Data/Parameter	h_n
Unit	Hours
Description	Number of hours in monitoring period *n* during which the plant was in operation
Measured/Calculated /Default	Measured
Source of data	Fatima production log and continuous monitoring according to operational parameters
Value(s) of monitored parameter	2,604
Monitoring equipment	The total operating hours are logged continuously in the production log.
Measuring/Reading/ Recording frequency	Continuously
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	-

Data/Parameter	$T_{open,n}$
Unit	%
Description	Fraction of time in monitoring period *n* during which the by-pass valve on the line feeding the tertiary N_2O abatement facility was open to vent the gas directly to the atmosphere.
Measured/Calculated /Default	Measured
Source of data	N/A
Value(s) of monitored parameter	0
Monitoring equipment	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	N/A
QA/QC procedures	N/A
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	No by-pass is foreseen in the project design and therefore no by-pass valve will be installed from the beginning of the project activity. If necessary, plant will shut down.

Data/Parameter	$PE_{FF,n}$ (corresponding to $PE_{CO2,tertiary,n}$)
Unit	tCO_2e
Description	Project emissions related to fossil fuel input to the destruction facility and/or re-heater in monitoring period *n* (tCO_2)
Measured/Calculated /Default	calculated
Source of data	The emissions related to the operation of the N_2O destruction facility include only on-site emissions due to fossil fuel use as input to the N_2O destruction facility. Natural gas consumption will be measured by a mass-flow meter
Value(s) of monitored parameter	689.1
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Continuously
Calculation method **(if applicable)**	Calculated based on measurement of natural gas consumption according to the following formula, as provided in the applicable tool “Tool to calculate project or leakage CO2 emissions from fossil fuel combustion” (Version 02): (2) $PE_{FF,n} = PE_{FC,j,y}$ (3) $PE_{FC,j,n} = \sum_i FC_{i,j,n} * COEF_{i,n}$ (4) $COEF_{i,n} = w_{C,i,y} * 44/12$ Where: $PE_{FC,j,n}$ = CO_2 emissions from fossil fuel combustion in process *j* in monitoring period *n* (tCO_2/yr) $FC_{i,j,n}$ = Quantity of fuel type *i* combusted in the process *j* during the monitoring period *n* (mass or volume unit/yr) $COEF_{i,n}$ = CO_2 emission coefficient of fuel type *i* in monitoring period *n* (tCO_2/mass or volume unit) i = Fuel types combusted in process *j* during monitoring period *n* $w_{C,i,y}$= Is the weighted average mass fraction of carbon in fuel type *i* in year *y* (tC/mass unit of the fuel)

<table>
<tr><td>QA/QC procedures</td><td>Maintenance and calibration of the mass flow meter is applied under the internal QA/QC procedures.
TAG number / model specification of meter: FIT-7672 / 2700C
<table><tr><td>Overall measurement accuracy</td><td>+/- 0.5% of the adjusted range</td></tr><tr><td>Serial Number</td><td>3791557</td></tr><tr><td>Calibration frequency</td><td>Once per 5 years</td></tr><tr><td>Date of last calibration</td><td>30/10/2008</td></tr><tr><td>Valid until</td><td>29/10/2013</td></tr></table></td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions or actual net GHG removals by sinks</td></tr>
<tr><td>Additional comment</td><td>Calibration schedules are performed according to plant internal procedure:
SOP No. 11</td></tr>
</table>

Data/Parameter	$w_{C,i,y}$
Unit	tC/mass unit of fuel type natural gas
Description	Weighted average mass fraction of carbon in fuel type *i* in year *y*
Measured/Calculated /Default	Measured
Source of data	The following data source may be used if the relevant conditions apply: **Data source** — **Conditions for using the data source** a) Values provided by the fuel supplier in invoices — This is the preferred source b) Measurements by the project participants — If a) is not available **Option b)** has been applied since values from the supplier have not been available.
Value(s) of monitored parameter	0.777
Monitoring equipment	-
Measuring/Reading/ Recording frequency	The mass fraction of carbon should be obtained for each fuel delivery, from which weighted average annual values should be calculated. The exact chemical composition of the fuel is analyzed on a weekly basis in the Fatima laboratory.
Calculation method (if applicable)	-
QA/QC procedures	Verify if the values under a) and b) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in b) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	The results of the analyses are being tracked in laboratory analysis sheets.

Data/Parameter	**$FC_{i,j,y}$**
Unit	Mass unit per year (ton/yr)
Description	Quantity of fuel type *i* combusted in process *j* during the year y
Measured/Calculated /Default	Measured
Source of data	Measurements from Coriolis mass flow meter
Value(s) of monitored parameter	242.01
Monitoring equipment	Coriolis mass flow meter
Measuring/Reading/ Recording frequency	Continuously.
Calculation method (if applicable)	-
QA/QC procedures	Maintenance and calibration of the mass flow meter is applied under the internal QA/QC procedures. TAG number / model specification of meter: FIT-7672 / 2700C Overall measurement accuracy: *+/- 0.5% of the adjusted range* Serial Number: *3791557* Calibration frequency: *annually* Date of last calibration: *30/10/2008* Valid until: *29/10/2013*
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	Calibration schedules are performed according to plant internal procedure: SOP No. 11

Data/Parameter	$\mathbf{V_{t,wb}}$
Unit	Nm^3 wet gas/h
Description	Volumetric flow of the gaseous stream in time interval *t* on a wet basis
Measured/Calculated /Default	Measured
Source of data	Measurements from Durag Annubar D-FL 100 flow meter
Value(s) of monitored parameter	Average value: 173,132
Monitoring equipment	Durag Annubar D-FL 100 flow meter
Measuring/Reading/ Recording frequency	Continuously
Calculation method (if applicable)	-
QA/QC procedures	TAG number / model specification of meter: FT 7681/D-FL 100: Measurement accuracy: <0.9 m/s Serial Number: 1223310 Calibration frequency: *Annually by QAL2 /AST; Additional daily checks on operating conditions are performed as well as monthly calibration checks (with calibration gas cylinders)* Date of last calibration: ***QAL2*** *27/03/2012 – 30/03/2010* *valid until*: *26/03/2013 (next AST), 26/03/2017 (next QAL2)* QAL2 factor: 1.02
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	QAL2-3 calibration schedules are performed according to plant internal procedures: SOP No. 14 (stack gas flow meter)

Data/Parameter	**$v_{i,t,db}$**
Unit	m^3 gas *i*/m^3 dry gas
Description	Volumetric fraction of greenhouse gas *i* in a time interval *t* on a dry basis
Measured/Calculated /Default	Continuously
Source of data	Measurements from ABB EL3020 URAS 26 N_2O Analyzer
Value(s) of monitored parameter	
Monitoring equipment	ABB EL3020 URAS 26 N_2O Analyzer
Measuring/Reading/ Recording frequency	Continuously
Calculation method (if applicable)	-
QA/QC procedures	Calibration includes zero verification with an inert gas (e.g. N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases have a certificate provided by the manufacturer and are under their validity period. TAG number / model specification of meter: AT-7640 / EL3020 N_2O Analyzer Measurement accuracy: *+/- 1% of the adjusted range* Serial Number: *0241234806 / 1000* Calibration frequency: *Annually by QAL2 /AST; Additional daily checks on operating conditions are performed as well as monthly calibration checks (with calibration gas cylinders)* Date of last calibration: ***QAL2*** *29/03/2012* *valid until*: *28/03/2013 (next AST), 28/03/2017 (next QAL2)* QAL2 factor:0.97
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	QAL2-3 calibration schedules are performed according to plant internal procedures: SOP No. 10

Data/Parameter	**T_t**
Unit	°C
Description	Temperature in the gaseous stream in time interval *t*
Measured/Calculated /Default	Measured
Source of data	Tail gas temperature measurement
Value(s) of monitored parameter	N/A
Monitoring equipment	Thermocouples
Measuring/Reading/ Recording frequency	Continuously
Calculation method (if applicable)	-
QA/QC procedures	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	As parameters are converted to normal conditions during the monitoring process, this parameter is not needed. Calibration schedules are performed according to plant internal procedures: SOP No. 5

Data/Parameter	P_t
Unit	Pa
Description	Pressure of the gaseous stream in time interval *t*
Measured/Calculated /Default	Measured
Source of data	Pressure probe
Value(s) of monitored parameter	-
Monitoring equipment	Pressure probe
Measuring/Reading/ Recording frequency	Continuously
Calculation method (if applicable)	-
QA/QC procedures	Periodic calibration against a primary device must be performed periodically and records of calibration procedures must be kept available as well as the primary device and its calibration certificate. Pressure transducers (either capacitive or resistive) must be calibrated monthly.
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	As parameters are converted to normal conditions during the monitoring process, this parameter is not needed. Calibration schedules are performed according to plant internal procedures: SOP No. 2

Data/Parameter	**ER_n**
Unit	tCO_2e
Description	Emission reductions in monitoring period
Measured/Calculated /Default	Calculated
Source of data	-
Value(s) of monitored parameter	164,738
Monitoring equipment	-
Measuring/Reading/ Recording frequency	-
Calculation method (if applicable)	(5) $ER_n = BE_n - PE_n$
QA/QC procedures	-
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comment	-

D.3. Implementation of sampling plan

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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 calculation of the baseline emissions or baseline net GHG removals by sinks has been established in accordance with ACM0019 V.01.0.0. In the following a sample baseline calculation applying summed up figures will be presented. The formulae numbering is in line with the numbering in the registered PDD.

(1) $BE_n = P_{NA,n} * EF_{BL,N2O,n} * GWP_{N2O} * 10^{-3}$

Where:

BE_n = Baseline emissions in monitoring period *n* (tCO_2e)

$P_{NA,n}$ = Nitric acid produced in the monitoring period *n* ($tHNO_3$)

$EF_{BL,N2O,n}$ = Baseline N_2O emission factor for nitric acid production in the monitoring period *n* ($kgN_2O/tHNO_3$).

GWP_{N2O} = Global Warming Potential of N_2O valid for the commitment period (310 tCO_2e)

Sample calculation applying summed-up values of the whole monitoring period:

BE_n	P_{NA}	$EF_{BL,N2O,n}$	GWP_{N2O}	
165,720	137,072	3.90	310	0.001

Determination of the baseline N_2O emission factor ($EF_{BL,N2O,n}$)

The baseline N_2O emission factor in the monitoring period *n* ($EF_{BL,N2O,n}$) shall be determined as a default emission factor $EF_{default,y}$ given for each calendar year *y* for which BE_n is calculated (see monitoring tables for $EF_{default,y}$), as follows:

(2) $EF_{BL,N2O,n} = EF_{default,y}$

Where:

$EF_{BL,N2O,n}$ = Baseline N_2O emission factor for nitric acid production in the monitoring period *n* ($kgN_2O/tHNO_3$).

$EF_{default,y}$ = Default N_2O baseline emissions factor in the calendar year *y* of the monitoring period *n* ($kgN_2O/tHNO_3$) (see list of $EF_{default,y}$ values under D.1).

Year	$EF_{BL,N2O,2012}$	$EF_{default,2012}$
2012	3.90	3.90

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

>>

Project emissions include emissions of N_2O which have not been destroyed by the project activity and, in case of the installation of a tertiary N_2O abatement facility, CO_2 emissions resulting from the operation of the N_2O abatement facility.

Project emissions are calculated using the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02) referred to in ACM0019.

Project emissions are calculated as follows:

(3) $$PE_n = PE_{N2O,n} + PE_{CO2,tertiary,n}$$

Where:

PE_n = Project emissions in monitoring period *n* (tCO_2e)

$PE_{N2O,n}$ = Project emissions of N_2O from the project plant in monitoring period *n* (tCO_2e)

$PE_{CO2,tertiary,n}$ = Project emissions of CO_2 from the operation of the tertiary N_2O abatement facility in monitoring period *n* (tCO_2)

Sample calculation applying summed-up values of the whole monitoring period:

PE_n	$PE_{N2O,n}$	$PE_{CO2,tertiary,n}$
982.00	292.92	689.08

The amount of N_2O emissions from the project activity includes two emission sources:

- The N_2O contained in the tail gas stream of the plant which is released to the atmosphere and;
- In the case of a tertiary N_2O abatement, the N_2O contained in any by-pass streams to the tertiary N_2O abatement facility.

(4) $$PE_{N2O,n} = (Q_{N2O,tail\ gas,n} + Q_{N2O,by\text{-}pass,n}) * GWP_{N2O}$$

Where:

$PE_{N2O,n}$ = Project emissions of N_2O from the project plant in monitoring period *n* (tCO_2e)

$Q_{N2O,tail\ gas,n}$ = Amount of N_2O released through the tail gas of the project plant to the atmosphere in monitoring period *n* (tN_2O)

$Q_{N2O,\ by\text{-}pass;n}$ = Amount of N_2O released through the by-pass to a tertiary N_2O abatement system to the atmosphere in monitoring period *n* (tN_2O)[3]

[3] Please note that for the underlying project activity no by-pass option is foreseen in the current project design. Accordingly, no by-pass emissions will occur throughout the project activity. However, in order to comply with

GWP_{N2O} = Global warming potential of N_2O valid for the commitment period (310 tCO_2e)

Sample calculation applying summed-up values of the whole monitoring period:

$PE_{N2O,n}$	$Q_{N2O,tail\ gas,n}$	$Q_{N2O,by\text{-}pass,n}$	GWP_{N2O}
292.92	0.94	0	310

Determination of $Q_{N2O,tail\ gas,n}$

The amount of N_2O emissions from the tail gas stream of the project plant shall be determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream." In applying the tool, the following provisions apply:

- Throughout the crediting periods of the project activity, the N_2O concentration and volume or mass flow of the tail gas are to be monitored continuously. The monitoring system is to be installed and maintained throughout the crediting period based on the European Norm 14181 (2004), or any more recent update of that standard;
- The monitoring system should provide separate hourly average values for the N_2O concentration and the volume or mass flow of the tail gas based on 2 seconds (or shorter) interval readings that are recorded and stored electronically. These N_2O data sets shall be identified by means of a unique time / date key indicating when exactly the values were observed;
- The correction factors derived from the calibration curve of the QAL2 audit for the monitoring components as determined during the QAL2-test in accordance with EN 14181 must be applied to both the N_2O concentration and the volume or mass flow of the tail gas. This can either be applied automatically to the raw data recorded by the data storage system at the plant or it can be applied to the calculated hourly averages as part of the calculation of project emissions;
- If data for either the N_2O concentration or the volume or mass flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N_2O concentration or volume or mass flow of the tail gas observed during the monitoring period. If data for neither the N_2O concentration nor the volume or mass flow of the tail gas are available for more than 1/3 of any hour while the plant was in operation, the maximum value of mass flow of N_2O calculated during the monitoring period shall be applied to any such hour. Values observed during five operating hours before and after a plant start-up and shut-down shall not be used for the determination of the maximum values.

According to the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 02.0.0) the mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* ($F_{i,t}$) is calculated based on measurements of

a) the total volume flow or mass flow of the gas stream and
b) the volumetric fraction of the gas in the gaseous stream and
c) the water content and gas composition.

the methodology and for keeping up flexibility in the event of a possible by-pass installation at a later point of time the parameter $T_{open,n}$ will be monitored throughout the crediting period and has been added to section B.7.1.

The tool covers possible measurement options, providing six different calculation options to determine the volume or mass flow of a particular greenhouse gas (A-F).

Furthermore, the tool provides two options for the determination of the moisture content of the gaseous stream, while **Option 2** (simplified calculation without measurement of the moisture content) will be applied.

This option provides a simple and conservative approach to determine the absolute humidity by assuming the gaseous stream is dry or saturated depending on which is the conservative situation.

In order to follow a conservative approach for the determination of the project emissions the gaseous stream is assumed to have a moisture content of “0” and is therefore considered dry.

As the gaseous stream is assumed to be dry **Option B** is chosen for the calculation of the mass flow of greenhouse gas *i* ($F_{i,t}$), which is calculated as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \quad (5)$$

With:

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \quad (6)$$

Where:

$F_{i,t}$	= mass flow of greenhouse gas N_2O in the gaseous stream in time interval *t* (kg gas /h)
$V_{t,db}$	= Volumetric flow of the gaseous stream in time interval *t* on dry basis (m^3 dry gas/h)
$v_{i,t,db}$	= Volumetric fraction of greenhouse gas N_2O in the gaseous stream in a time interval *t* on a dry basis (m^3 gas N_2O/m^3 dry gas)
$\rho_{i,t}$	= Density of greenhouse gas N_2O in the gaseous stream in a time interval *t* (kg gas N_2O/m^3 gas N_2O)
P_t	= Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_i	= Molecular mass of greenhouse gas N_2O (kg/kmol)
R_u	= Universal ideal gases constant ($Pa.m^3/kmol.K$)
T_t	= Temperature of the gaseous stream in time interval *t* (K)

Sample calculation for equation (5)applying values from 31/07/2012 17:00:

$F_{i,t}$	$V_{t,db}$	$v_{i,t,db}$	$p_{i,t}$
0.33	154,681	0.0000011	1.964

Calculation for equation (6) applying summed up values for the whole of the monitoring period:

$p_{i,t}$	P_t	MM_{N2O}	Ru	T_t
1.96	101.325	44.02	8.314	273.150

The volumetric flow of the gaseous stream in time interval *t* on a dry basis ($V_{t,db}$) is determined by converting the measured volumetric flow from wet basis to dry basis. The absolute humidity of the gaseous stream (**$m_{H2O,t,db}$**) is determined using **Option 2** above and accordingly **set to be 0**. Consequently, equation (8) will result in 0 and thus equation (7) will result in:

$$V_{t,db} = V_{t,wb}/(1 + V_{H2O,t,db}) = V_{t,wb} \tag{7}$$

Where:

$V_{t,db}$ = Volumetric flow of the gaseous stream in time interval *t* on dry basis (m^3 dry gas/h)
$V_{t,wb}$ = Volumetric flow of the gaseous stream in time interval *t* on a wet basis (m^3 dry gas/h)
$v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval t on a dry basis (m^3 H_2O/m^3 dry gas)

Sample calculation applying values from 31/07/2012 17:00:

$V_{t,db}$	$V_{t,wb}$	$1 + V_{H2O,t,db}$
154,681	154,681	1

The volumetric fraction of H_2O in time interval *t* on a dry basis ($v_{H2O,t,db}$) is estimated according to equation (8):

$$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}} \tag{8}$$

Where:

$v_{H2O,t,db}$ = Volumetric fraction of H_2O in the gaseous stream in time interval *t* on a dry basis (m^3 H_2O/m^3 dry gas)
$m_{H2O,t,db}$ = Absolute humidity in the gaseous stream in time interval *t* on a dry basis (kg H_2O/kg dry gas)
$MM_{t,db}$ = Molecular mass of the gaseous stream in time interval *t* on a dry basis (kg dry gas/kmol dry gas)
MM_{H2O} = Molecular mass of H_2O (kg H_2O/kmol H_2O)

As stated above, $m_{H2O,t,db}$ is assumed to be 0. Accordingly $V_{H2O,t,db}$ results in0 as applied in equation (7).

The hourly values are then aggregated for the duration of the monitoring period *n*, as provided in ACM0019:

$$Q_{N2O,tailgas,n} = \sum_{h=1}^{h=h_n} F_{N2O,tailgas,h} * 10^{-3} \tag{9}$$

Where:
$Q_{N2O,tailgas,n}$ = Amount of N_2O released through the tail gas of the project plant to the atmosphere in monitoring period *n* (tN_2O)
$F_{N2O,tailgas,h}$ = Mass flow of N_2O in the gaseous stream of the tail gas in the hour *h* (kgN_2O/h)

h_n = Number of hours in monitoring period *n* during which the plant was in operation

Sample calculation applying summed-up values of the whole monitoring period:

$Q_{N2O,tail\ gas,n}$	$\sum F_{N2O,tail\ gas,h}$	
0.94	944.91	0.001

During any periods in which a tertiary abatement system is by-passed, $F_{N2O,tailgas,h}$ is set to zero in order to avoid double counting of project emissions.

(10) $$Q_{N2O,\ by\text{-}pass;n} = EF_{BL,\ N2O,n} * P_{NA.n} * T_{open,n} * 10^{-3}$$

Where:

$Q_{N2O,\ by\text{-}pass;n}$ = Amount of N_2O released through the by-pass to a tertiary N_2O abatement system to the atmosphere in monitoring period *n* (tN_2O)

$EF_{BL,\ N2O,n}$ = Default N_2O baseline emissions factor in the calendar year y oyf the monitoring period *n* ($kgN_2O/t\ HNO_3$)

$P_{NA.n}$ = Nitric acid produced in the monitoring period *n* ($tHNO_3$)

$T_{open,n}$ = Fraction of time in monitoring period *n* during which the by-pass valve on the line feeding the tertiary N_2O abatement facility was open to vent the gas directly to the atmosphere.

Sample calculation applying summed-up values of the whole monitoring period:

$Q_{N2O,by\text{-}pass,n}$	$EF_{BL,N2O,n}$	P_{NA}	$T_{open,n}$	
0.00	3.90	137,072	0	0.001

Project emissions from the operation of the tertiary N_2O abatement facility ($PE_{CO2,tertiary,n}$)

The emissions related to the operation of the N_2O destruction facility include only on-site emissions due to the fossil fuel use as input to the N_2O destruction facility:

(11) $$PE_{CO2,tertiary,n} = PE_{FF,n}$$

Where:

$PE_{CO2\ ,tertiary,n}$ = Project emissions of CO_2 from the operation of the tertiary N_2O abatement facility in monitoring period *n* (tCO_2)

$PE_{FF,n}$ = Project emissions related to fossil fuel input to the destruction facility and/or re-heater in monitoring period *n* ($t\ CO_2$)

For the determination of the project emissions related to the operation of the tertiary abatement system in monitoring period *n* the project proponents are required to use the latest version of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion.”

The parameter $PE_{FC,j,y}$ used in the tool corresponds to the parameter $PE_{FF,n}$ in the applied methodology.

(12) $PE_{FF,n} = PE_{FC,j,y}$

CO_2 emissions from fossil fuel combustion in process *j* are calculated based on the quantity of fuels combusted and the CO_2 emission coefficient of those fuels, as follows:

(13) $PE_{FC,j,n} = \sum_i FC_{i,j,n} * COEF_{i,n}$

Where:

$PE_{FC,j,n}$ = CO_2 emissions from fossil fuel combustion in process *j* in monitoring period *n* (tCO_2/yr)
$FC_{i,j,n}$ = Quantity of fuel type *i* combusted in the process *j* during the monitoring period *n* (mass or volume unit/yr)
$COEF_{i,n}$ = CO_2 emission coefficient of fuel type *i* in monitoring period *n* (tCO_2/mass or volume unit)
i = Fuel types combusted in process *j* during monitoring period *n*

Sample calculation applying summed-up values of the whole monitoring period:

$PE_{CO2,tertiary,n}$	$\sum FC_{i,j,n}$	$COEF_{i,n}$
689.08	242.01	2.847

As data about the chemical composition of the fuel type *i* is available $COEF_{i,n}$ is calculated based on its chemical composition of the fossil fuel type *i* using Option A of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 02):

(14) $COEF_{i,n} = w_{C,i,y} * 44/12$

Where:

$COEF_{i,n}$ = CO_2 emission coefficient of fuel type *i* in monitoring period *n* (tCO_2/mass or volume unit)
$w_{C,i,y}$ = Is the weighted average mass fraction of carbon in fuel type *i* in year *y* (tC/mass unit of the fuel)

Sample calculation applying summed-up values of the whole monitoring period:

$COEF_{i,n}$	$w_{C,i,y}$	
2.847	0.777	44/12

$w_{C,i,y}$ is calculated according to a mass fraction calculation of carbon in the fuel type applied:

Name	Molar weight	Unit	Fraction in %
M_C	12.0107	g/mol	
M_{CH4}	16.043	g/mol	72.44
M_{C2H6}	30.07	g/mol	0.20
M_{CO2}	44.01	g/mol	8.60

E.3. Calculation of leakage

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Any leakage emissions sources are deemed to be negligible.

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

Time Period	Baseline emissions or baseline net GHG removals by sinks (tCO_2e)	Project emissions or actual net GHG removals by sinks (tCO_{2e})	Leakage (tCO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (tCO_2e)
Total	165,720	982	0	164,738

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 (tCO_2e)	192,445	164,738

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

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Not applicable.

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History of the document

Version	Date	Nature of revision
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	EB 54, Annex 34 28 May 2010	Initial adoption.
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