Monitoring report form
(Version 03.2)

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	1
Completion date of the monitoring report	07/04/2014
Registration date of the project activity	01/04/2012
Monitoring period number and duration of this monitoring period	Monitoring period No. 2 01/08/2012 – 31/03/2014 Duration (days): 608
Project participant(s)	• Fatima Fertilizer Company Limited • N.serve Environmental Services GmbH
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	913,182 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	803,3339 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period up to 31 December 2012(if applicable)	180,233 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved during the period from 1 January 2013 onwards (if applicable).	623,106 tCO_2e

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 designed 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 above 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
29/11/2011	Installation of Durag Annubar D-FL 100(Stack gas flow meter)
01/12/2011	Commissioning of the ENVINOx unit in Fatima’s nitric acid plant (Tertiary N_2O abatement system)
11/02/2012	Installation of ABB EL 3020 Uras 26 analyser (AMS for N_2O monitoring)
01/04/2012	Registration to the UNFCCC
01/04/2012	Start of Crediting Period
01/04/2012	Start of 1st Monitoring Period
31/07/2012	End of 1st Monitoring Period
01/08/2012	Start of 2nd Monitoring Period
16/07/2013	Installation of new ABB EL 3020 Uras 26 analyser (AMS for N_2O monitoring) due to malfunctioning of the former item
31/03/2014	End of 2nd Monitoring Period

Table 1: Implementation schedule of the project activity

(d)

Total GHG emission reductions achieved in this monitoring period: 803,342 tCO_2e.

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	No
United Kingdom of Great Britain and Northern Ireland	N.serve Environmental Services GmbH Fatima Fertilizer Company Limited	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: 01/08/2012

(d) End date of this Monitoring Period: 31/03/2014

(e) Length of this Monitoring Period: 608 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:

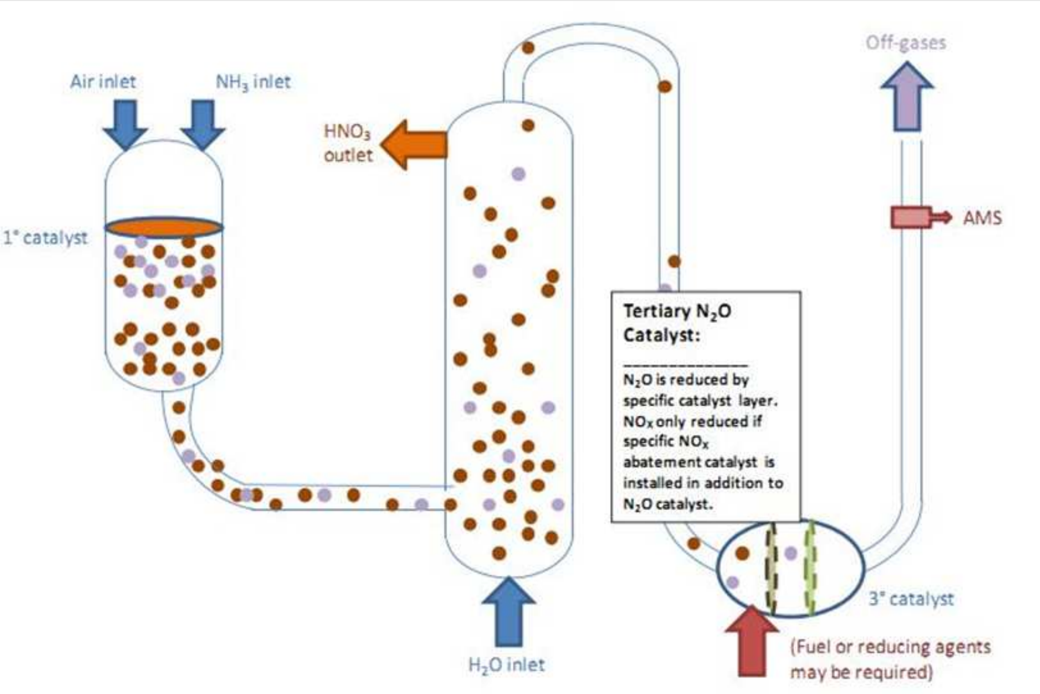

Figure 1: Image flow of tertiary catalyst unit

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 tables 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:

AMS downtimes/irregular calibrations

From	To	Event	Explanation/Action
24.04.2013 10:00	25.04.2013 11:00	AST	regular AST
16.06.2013 00:00	15.07.2013 23:00	Zero-Point Calibrations (QAL3) of analyzer irregular	problems with the analyzer, start of malfunctioning
16.07.2013 14:00	27.01.2014 09:00	exchanged analyzer without QAl2	original analyzer has been malfunctioning and therefore been replaced by new analyzer
27.01.2014 10:00	27.01.2014 12:00	QAL2 for complete measurement equipment including new analyzer	

Table 2: Production related events during Monitoring Period

Plant events

From	To	Event	Explanation/Action
09.08.12 06:05	10.08.12 00:10	Tripping of NA Plant	NA Plant tripped at 05:55 hrs due to malfunctioning of PSZH 6148,NO Compressor discharge pressure high switch.

09.08.12 06:05	10.08.12 01:04	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant tripped at 05:55 hrs due to malfunctioning of PSZH 6148,NO Compressor discharge pressure high switch.
09.08.12 06:05	10.08.12 01:17	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant tripped at 05:55 hrs due to malfunctioning of PSZH 6148,NO Compressor discharge pressure high switch.
10.08.12 12:56	13.08.12 04:53	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)due to low Ammonia Inventory in Ammnonia Storage Tank
10.08.12 12:56	13.08.12 05:45	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	Due to sufficient Inventory of NA in Storage tank,NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped)due to low Ammonia Inventory in Ammnonia Storage Tank
10.08.12 12:48	13.08.12 05:48	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	Due to sufficient Inventory of NA in Storage tank,NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped)due to low Ammonia Inventory in Ammnonia Storage Tank
21.08.12 02:28	01.09.12 00:00	Safe Shutdown of NA Plant	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped)due to planned shut down for maintenance activities(Annual turn around)
21.08.12 02:29	01.09.12 00:00	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped)due to planned shut down for maintenance activities(Annual turn around)
21.08.12 02:30	01.09.12 00:00	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped)due to planned shut down for maintenance activities(Annual turn around)
21.08.12 02:28	16.09.12 14:35	Safe Shutdown of NA Plant	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped)due to planned shut down for maintenance activities(Annual turn around)
21.08.12 02:29	16.09.12 15:01	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped)due to planned shut down for maintenance activities(Annual turn around)
21.08.12 02:30	16.09.12 15:23	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped)due to planned shut down for maintenance activities(Annual turn around)
16.09.12 15:43	17.09.12 00:00	Safe Shutdown of NA Plant	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped) due to severe leakage of NOX in Burner Hall caused by slippage of rupture disc(SV 121) in NOX line
16.09.12 15:43	17.09.12 00:17	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped) due to severe leakage of NOX in Burner Hall caused by slippage of rupture disc(SV 121) in NOX line
16.09.12 15:43	17.09.12 00:42	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped) due to severe leakage of NOX in Burner Hall caused by slippage of rupture disc(SV 121) in NOX line

18.09.12 10:39	18.09.12 15:00	Tripping of NA Plant	NA Plant tripped due to malfunctioning of PSZH 6148(Nox Compressure discharge high pressure switch)
18.09.12 10:39	18.09.12 15:22	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant tripped due to malfunctioning of PSZH 6148(Nox Compressure discharge high pressure switch)
18.09.12 10:39	18.09.12 15:42	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant tripped due to malfunctioning of PSZH 6148(Nox Compressure discharge high pressure switch)
20.09.12 13:09	20.09.12 22:50	Tripping of NA Plant	NA Plant tripped due to malfunctioning of PSZH 6148(Nox Compressure discharge high pressure switch) caused be ESD hardware failure
20.09.12 13:09	20.09.12 23:15	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant tripped due to malfunctioning of PSZH 6148(Nox Compressure discharge high pressure switch) caused be ESD hardware failure
20.09.12 13:09	20.09.12 23:37	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant tripped due to malfunctioning of PSZH 6148(Nox Compressure discharge high pressure switch) caused be ESD hardware failure
27.09.12 17:50		Safe Shutdown of NA Plant	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped)due to low Ammonia inventory in Storage tank caused by tripping of Ammonia Plant
27.09.12 17:51		DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped)due to low Ammonia inventory in Storage tank caused by tripping of Ammonia Plant
27.09.12 17:52		EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped by actuating IS-1(IS-1 means Ammonia supply to Burner stopped)due to low Ammonia inventory in Storage tank caused by tripping of Ammonia Plant
10.11.12 21:41	11.11.12 11:50	Tripping of NA Plant	NA Plant tripped due to Power failure at site (GTG tripping)
10.11.12 21:41	11.11.12 12:14	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant tripped due to Power failure at site (GTG tripping)
10.11.12 21:41	11.11.12 12:48	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant tripped due to Power failure at site (GTG tripping)
06.01.13 00:00	07.01.13 02:05	Safe Shut down of NA Plant	NA Plant stopped due to low Ammonia Inventory
06.01.13 00:00	07.01.13 02:37	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped due to low Ammonia Inventory
06.01.13 00:00	07.01.13 03:09	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped due to low Ammonia Inventory
17.01.13 21:32	21.01.13 03:09	Safe Shut down of NA Plant	NA Plant stopped due to low Ammonia Inventory
17.01.13 21:32	21.01.13 03:59	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped due to low Ammonia Inventory
17.01.13 20:41	21.01.13 04:14	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped due to low Ammonia Inventory

31.03.13 07:45	Continue	Safe Shut down of NA Plant	NA Plant stopped due to ATA-2013(Annual Turn around)
31.03.13 07:45	Continue	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped due to ATA-2013
31.03.13 07:34	Continue	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped due to ATA-2013
31.03.13 07:45	18.04.13 05:15	Safe Shut down of NA Plant	NA Plant stopped due to ATA-2013(Annual Turn around)
31.03.13 07:45	18.04.13 06:17	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped due to ATA-2013
31.03.13 07:34	18.04.13 06:40	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped due to ATA-2013
21.04.13 11:23	24.04.13 10:20	Safe Shut down of NA Plant	NA Plant stopped due to low Ammonia Inventory
21.04.13 11:23	24.04.13 11:12	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped due to low Ammonia Inventory
21.04.13 11:10	24.04.13 11:35	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped due to low Ammonia Inventory
26.05.13 17:56	30.05.13 01:38	Safe Shut down of NA Plant	NA Plant stopped for rectification of Nox compressor leakage.
26.05.13 17:53	30.05.13 02:02	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant stopped for rectification of Nox compressor leakage.
26.05.13 17:56	30.05.13 02:23	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant stopped for rectification of Nox compressor leakage.
05.10.13 11:42	05.10.13 15:32	NA Plant tripping	NA Plant tripped due to false indication of Temperature indicator at import steam.
05.10.13 11:42	05.10.13 16:02	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant tripped due to false indication of Temperature indicator at import steam.
05.10.13 11:42	05.10.13 16:19	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant tripped due to false indication of Temperature indicator at import steam.
09.11.13 00:06	11.11.13 16:05	Safe Shut down of NA Plant	NA Plant was shutdown for Ammonia burner catalyst replacement
09.11.13 00:06	11.11.13 16:36	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant was shutdown for Ammonia burner catalyst replacement
09.11.13 00:02	11.11.13 16:52	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant was shutdown for Ammonia burner catalyst replacement
30.01.14 16:31	31.01.14 09:51	NA Plant tripping due to low vacuum In surface condenser.	Low vacuum in surface condenser due to high levels in condensate collecting boot.
30.01.14 16:31	31.01.14 12:49	DeNOX stopped/NH3 supply cut off due to NA Plant stoppage	NA Plant tripping
30.01.14 16:31	31.01.14 01:11	EnviNOX stopped/NG supply cut off due to NA Plant stoppage	NA Plant tripping

31.01.14 10:48	31.01.14 11:23	Shut down of NA Plant due to blockage of flow in final product acid line after startup.	Blockage caused high levels in bleacing and absorption tower hence plant was safely shutdown for rectification.

Table 3: Production related events during Monitoring Period

(b)

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
29/11/2011	Installation of Durag Annubar D-FL 100(Stack gas flow meter)
01/12/2011	Commissioning of the ENVINOx unit in Fatima's nitric acid plant (Tertiary N_2O abatement system)
11/02/2012	Installation of ABB EL 3020 Uras 26 analyser (AMS for N_2O monitoring)
01/04/2012	Registration to the UNFCCC
01/04/2012	Start of Crediting Period
01/04/2012	Start of 1st Monitoring Period
31/07/2012	End of 1st Monitoring Period
01/08/2012	Start of 2nd Monitoring Period
16/07/2013	Installation of new ABB EL 3020 Uras 26 analyser (AMS for N_2O monitoring) due to malfunctioning of the former item
31/03/2014	End of 2nd Monitoring Period

Table 4: 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

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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

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No.

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

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No.

B.2.5. Changes to start date of crediting period

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No.

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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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.

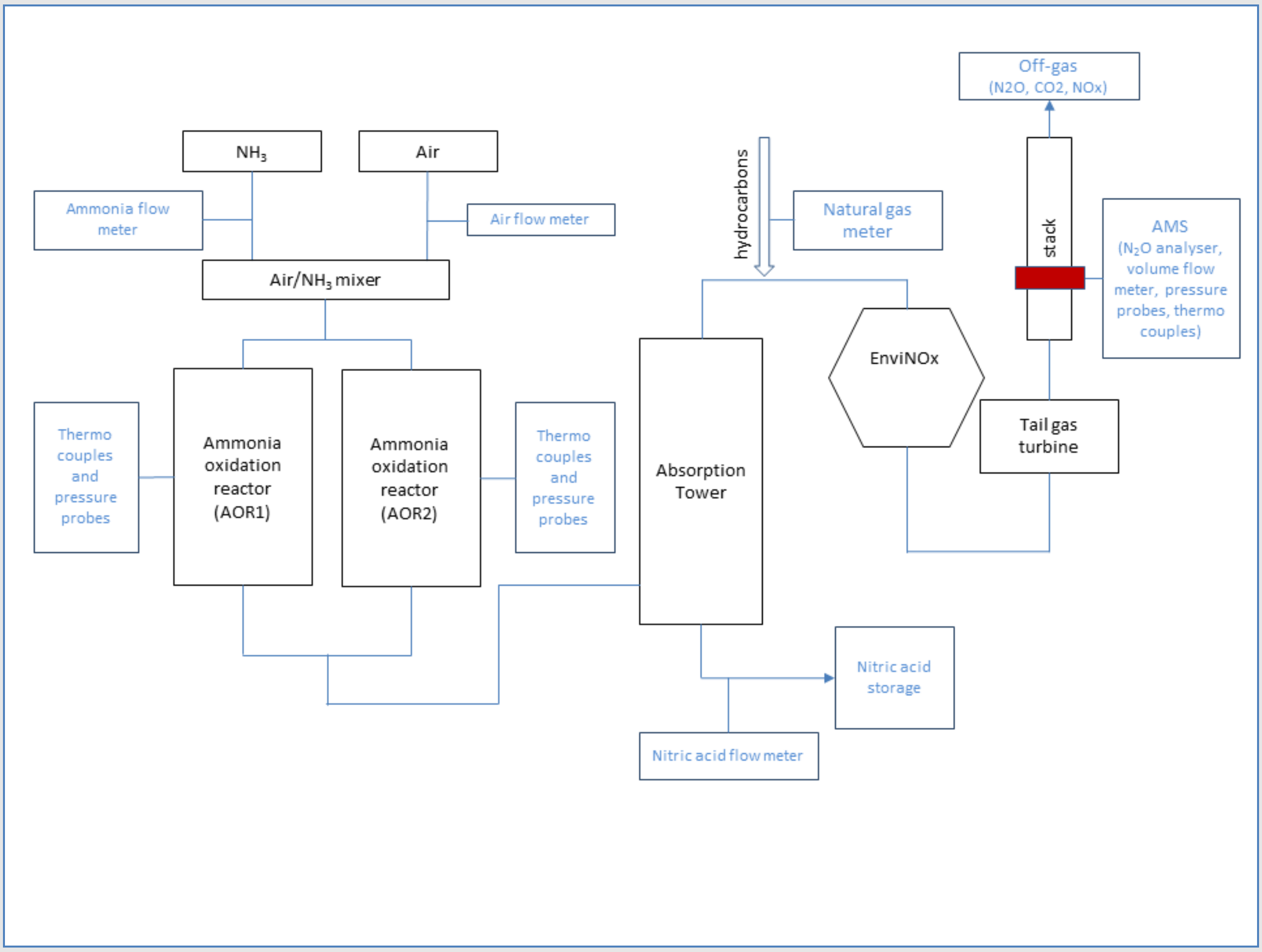

Figure 2: line diagram of nitric acid plant with tertiary abatement technology and positioning of measurement equipment

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 analyser. 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.

Analyser

The ABB EL3020 URAS 26 is capable of analysing 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 analyser features gas-filled opto-pneumatic detectors. The detector provides optimum sensitivity and high selectivity compared with the other gas components in the sample. The analyser is QAL1 and QAL2 tested (according to EN 14181) for the measurement of N_2O.

The plant is equipped with another two Emerson MLT N_2O analysers, one at the inlet of the EnviNOx and one at the outlet. The Emerson at the outlet is used to cross-check the measurement results of the ABB analyser and is also being QAL2/AST tested according to the annual schedule. Data have been submitted to N.serve but were not applied for the calculation of emission reductions.

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 analyser cabinet. Before being fed to the analyser, moisture is removed by a sample conditioning system that is installed in the analyser 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 analyser 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).

Additionally, a Venturi tube Kern VRB-420 transmitter is in operation. It is used to cross-check the D-FL 100 and is undergoing QAL2/AST tests according to the annual schedule. Data have been submitted to N.serve but were not applied for the calculation of emission reductions.

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 parts of the AMS to be subject to a quality control regime that will include regular maintenance and calibration according to the European Standard 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

[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.

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.

N_2O-Analyser Zero Calibration

Manual zero calibration is undertaken according to plant internal requirements based on vendor suggestions. Certified gas is being used. Additional automatic zero calibration is undertaken on daily basis using ambient air.

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 third day. Manual calibration checks are performed according to plant internal requirements and vendor suggestions with certified calibration gas. 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 is checked during the QAL2 and AST tests by an independent laboratory by comparison to a standard reference method (SRM) as stated above. 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.

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

Information flow

The below Figure 3 depicts the information flow from the AMS readings until the reporting to N.serve. The instruments measurements are being transferred automatically to the Delta-V data management systems and thereof to the EWS (Engineering Work Station). Since some of the plant's production figures are being applied for the emission reduction calculation, a rational has been programmed to extract these data from the plant to the Delta-V and ultimately to the EWS as well. The EWS stores the 1-second readings and comprises a back-up capacity of 12 years from the start of the project activity. Furthermore, the responsible engineer is building hourly averages of the readings by applying automated Excel-based formula. These are then back-upped on a second PC as well as on CDs, which are being transferred to another room of the complex. As a last step, the hourly averages are provided to N.serve for further processing on a monthly basis.

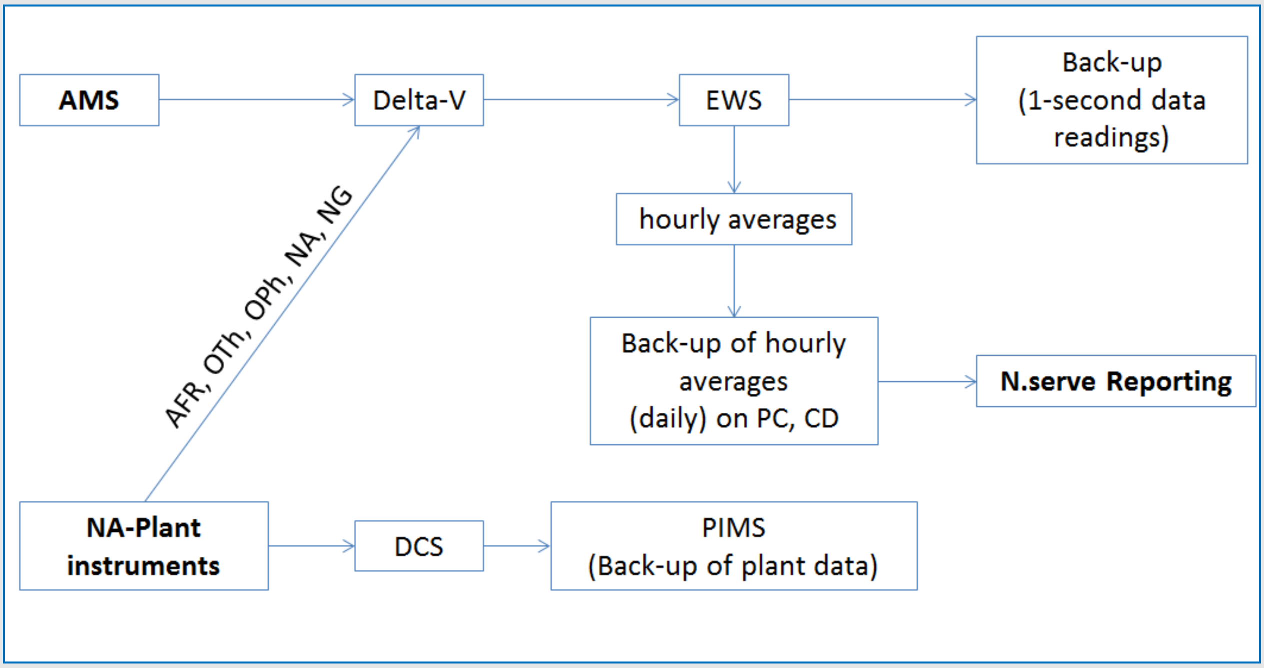

Figure 3: Information flow at Fatima plant

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 occurs later.

Document Control

The Project Manager has implemented 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 and the calculation of achieved emission reductions according to ACM0019 based on the raw data submitted by the plant owner. An internal technical review process was conducted and documented before such a report will be submitted for verification.

Data recording system

The CDM Project Manager has implemented a data recording system for collection and archiving of the

monitoring raw data. The data recording frequency for the continuously monitored parameters is 1 second. From these raw data hourly average values are calculated automatically.

Exclusion of data

Hours of plant downtime and hours of plant tripping (due to exceeding of security trip limits of the plant) have been excluded from the calculation of emission reductions as they do not represent normal operation of the plant.

Treatment of missing or corrupted data

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.

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):	see table below
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 $kgN_2O/tHNO_3$.

Year	Emissions factor ($kgN_2O/tHNO_3$)
2012	3.90
2013	3.70
2014	3.50
2015	3.40
2016	3.20
2017	3.00
2018	2.80
2019	2.70
2020	2.50
2021	2.50
Year n	2.50

Data / Parameter:	**GWP_{N2O}**
Unit:	tCO_2e/tN_2O
Description:	Global warming potential of nitrous oxide
Source of data:	Relevant decisions by the CMP
Value(s) applied):	310 (2012), 298 (2013, 2014)
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:	725,787
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 $tHNO_3/h$

QA/QC procedures:	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: F 6291/ IFC 100 KROHNE Overall measurement accuracy: *+/- 0.2% of the adjusted range* Serial Number: *A0830792* Calibration frequency: *Once per 5 years* Date of last calibration: *10/04/2012* Valid until: *10/04/2017* TAG number/ model specification of meter: DMA 4500 Density meter /Anton Paar: Overall measurement accuracy: *0.000011g/cm^3* Serial Number: *80374589* Calibration frequency: *Once per year* Date of last calibration: *10/07/2013, 10/07/2012* Valid until: *09/07/2014*
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	Calibration according to plant internal procedure SOP No. 12

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 Analyser Stack gas volume flow: Durag Annubar D-FL 100 flow meter
Value(s) of monitored parameter:	Average value for this monitoring period: 0,579 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 Analyser 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 (as done in present project). 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	

QA/QC procedures:	TAG number/ model specification of meter: AT-7640 / ABB EL3020 URAS 26 N_2O Analyzers

Measurement accuracy (for N_2O)	*< 1% of the span*
Serial Number Instrument A (in operation until 15/07/2013): Instrument B (in operation from 16/07/2013):	 *0241234806 / 1000* *0030D60D2F15*
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 calibrations	***QAL2*** *29/03/2012 – 31/03/2012* *27/01/2014 – 29/01/2014* ***AST:*** 24/04/2013 – 25/04/2013.
valid until	*26/01/2015 (next AST),* *26/01/2019 (next QAL2)*

TAG number/ model specification of meter:
FT7681 / Durag Annubar D-FL 100 flow meter

Measurement accuracy	< 2% of measurement range
Serial Number	1223310
Calibration frequency	*Annually by QAL2 /AST*; *Additional daily checks on operating conditions are performed.*
Date of last calibrations	***QAL2*** *29/03/2012 – 31/03/2012* *27/01/2014 – 29/01/2014* ***AST:*** *24/04/2013 – 25/04/2013*
valid until	*28/01/2015 (next AST),* *28/01/2019 (next QAL2)*

QAL2 correction factors:

Period	<16/07/2013	16/07/2013 – 29/01/2014	>29/01/2014
Analyzers	1.16	-	1.0686
Stack Gas Flow meter	1.02	1.02	1.059

Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks

Additional comment:	According to EN 14181, the flow meter and the analyser will be tested and calibrated by an external laboratory with EN ISO/IEC 17025 accreditation. The QAL2 test is usually conducted once every 3 years (although requirement is every 5 years); the AST test is conducted once per year. The AST is part of the QAL2 test. QAL2&3 tests schedules are performed according to plant internal procedures: SOP No. 10 (analyser) 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:	12,752
Monitoring equipment:	The total operating hours are logged continuously in the production log.
Measuring/ Reading/ Recording frequency:	Continuously
Calculation method (if applicable):	Plant trips (plant excessing the trip values OT < 800 – 920< and ammonia to air ratio >11.5) are considered as plant downtimes.
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:	$\mathbf{PE_{FF,n}}$ (corresponding to $\mathbf{PE_{CO2,tertiary,n}}$)
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:	2,810
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 CO_2 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)
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: *+/- 0.35% of mass flow* Serial Number: *3791557* Calibration frequency: *Once per 5 years* 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:	$w_{C,i,y}$
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:	0.75
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. Please note that April data were not available. Instead, the weighted average from the rest of the monitoring period was applied for the whole of the monitoring period (including April)
Calculation method (if applicable):	-
QA/QC procedures:	The values under b) have been checked against the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. The laboratory of the project participant is equipped with state-of-the-art instruments and adheres to high level of quality. The outcome of the measurement provides the following value: NCV: 44.4795 TJ/Gg (range: 46.5 TJ/Gg – 50.4 TJ/Gg) The value falls below the uncertainty range of the IPCC default values because of the low methane content and high CO_2-concentration of the natural gas of 71.94% during this monitoring period.
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. Calibration schedules are performed according to plant internal procedure: LAB-123A

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 mass flow meter
Value(s) of monitored parameter:	**Year** / **ton/yr** 2012 / 205.05 2013 / 626.23 2014 / 189.75 **Total** / **1,021.03**
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: *+/- 0.35% of mass flow* Serial Number: *3791557* Calibration frequency: *at least once every 5 years* 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:	$V_{t,wb}$
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:	weighted average value: 185,150.6
Monitoring equipment:	Durag Annubar D-FL 100 flow meter
Measuring/ Reading/ Recording frequency:	Continuously

Calculation method (if applicable):	Average value has been weighted reflecting different numbers of operating hours during Monitoring period in years 2012, 2013, 2014.
QA/QC procedures:	TAG number / model specification of meter: FT 7681/D-FL 100:

Measurement accuracy	< 2% of measurement range
Serial Number	1223310
Calibration frequency	*Annually by QAL2 /AST*; *Additional daily checks on operating conditions are performed.*
Date of last calibrations	***QAL2*** *29/03/2012 – 31/03/2012* *27/01/2014 – 29/01/2014* ***AST:*** *24/04/2013 – 25/04/2013*
valid until	*28/01/2015 (next AST),* *28/01/2019 (next QAL2)*

QAL2 correction factors:

Period	<29/01/2014	>29/01/2014
Stack Gas Flow meter	1.02	1.059

Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comment:	QAL2&3 test schedules are performed according to plant internal procedures: SOP No. 14 (stack gas flow meter)

Data / Parameter:	$\mathbf{v_{i,t,db}}$
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 Analyser
Value(s) of monitored parameter:	Average value: 0.0000017
Monitoring equipment:	ABB EL3020 URAS 26 N_2O Analyser
Measuring/ Reading/ Recording frequency:	Continuously
Calculation method (if applicable):	Average value has been weighted reflecting different numbers of operating hours during Monitoring period in years 2012, 2013, 2014.

QA/QC procedures:

N_2O-Analyser Zero Calibration

Manual zero calibration is undertaken every second week. Certified gas is being used. Additional automatic zero calibration is undertaken on daily basis using ambient air.

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 third day. 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.

All calibration gases have a certificate provided by the manufacturer and are under their validity period.

Dates of manual calibrations:

07/08/12, 07/09/12, 08/10/12, 23/10/12, 18/11/12, 03/12/12, 18/12/12, 02/01/13, 06/02/13, 21/02/13, 08/03/13, 22/03/13, [Annual Shutdown period] 12/05/13, 31/05/13, 15/06/13, 01/07/13, 09/07/13, 24/07/13, 08/08/13, 26/08/13, 10/09/13, 26/09/13, 11/10/13, 30/10/13, 21/11/13, 06/12/13, 23/12/13, 07/01/14, 24/01/14, 12/02/14, 27/02/14, 14/03/14, 31/03/14

TAG number / model specification of meter: AT-7640 / EL3020 N_2O Analyser

Measurement accuracy (for N_2O)	*< 1% of the span*
Serial Number Instrument A (in operation until 15/07/2013): Instrument B (in operation from 16/07/2013):	*0241234806 / 1000* *0030D60D2F15*
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 calibrations	***QAL2*** *29/03/2012 – 31/03/2012* *27/01/2014 – 29/01/2014* ***AST:*** 24/04/2013 – 25/04/2013.
valid until	*26/01/2015 (next AST),* *26/01/2019 (next QAL2)*

QAL2 correction factors:

Period	<16/07/2013	16/07/2013 – 29/01/2014	>29/01/2014
Analyzers	1.16	-	1.0686

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 The analyzer had malfunctioned and was exchanged on July 16th 2013. In the period between 16/07/2013 – 29/01/2014 the new analyzer (*0030D60D2F15)* had been operated without a QAL2 calibration. Therefore, all measurements during this period have been multiplied with the maximum analyzer uncertainty (as of QAL1 certification, for reference please see footnote 1) for the component N_2O (1.054).

<table>
<tr><th>Data / Parameter:</th><th>T_t</th></tr>
<tr><td>Unit:</td><td>°C</td></tr>
<tr><td>Description:</td><td>Temperature in the gaseous stream in time interval t</td></tr>
<tr><td>Measured/ Calculated / Default:</td><td>Measured</td></tr>
<tr><td>Source of data:</td><td>Tail gas temperature measurement</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>N/A</td></tr>
<tr><td>Monitoring equipment:</td><td>Thermocouples (integral parts of flow meter)</td></tr>
<tr><td>Measuring/ Reading/ Recording frequency:</td><td>Continuously</td></tr>
<tr><td>Calculation method (if applicable):</td><td>-</td></tr>
<tr><td>QA/QC procedures:</td><td>TAG number / model specification of transmitter: TI-6160 / D-XT 400 H-L100-E-D09-G1/2
<table>
<tr><td>Measurement accuracy</td><td>Δt ±(0.30 + 0.0050)</td></tr>
<tr><td>Calibration frequency</td><td>Annually by QAL2 /AST; Additional daily checks on operating conditions are performed.</td></tr>
<tr><td>Date of last calibration</td><td>QAL2
29/03/2012 – 31/03/2012
27/01/2014 – 29/01/2014

AST:
24/04/2013 – 25/04/2013.</td></tr>
<tr><td>valid until</td><td>26/01/2015 (next AST),
26/01/2019 (next QAL2)</td></tr>
</table>

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. The temperature transmitter is an integral part of the stack gas flow meter. Calibration is performed according to QAL2 and AST schedules once within 365 days together with the stack gas flow meter.</td></tr>
</table>

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.

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 (integral part of flow meter)
Measuring/ Reading/ Recording frequency:	Continuously
Calculation method (if applicable):	-
QA/QC procedures:	TAG number / model specification of transmitter: PT-7658/ D-FL 100 ADM-H <table><tr><td>Measurement accuracy</td><td>± *0.04%*</td></tr><tr><td>Calibration frequency</td><td>*Annually by QAL2 /AST; Additional daily checks on operating conditions are performed.*</td></tr><tr><td>Date of last calibration</td><td>***QAL2*** *29/03/2012 – 31/03/2012* *27/01/2014 – 29/01/2014* ***AST:*** 24/04/2013 – 25/04/2013.</td></tr><tr><td>*valid until*</td><td>*26/01/2015 (next AST), 26/01/2019 (next QAL2)*</td></tr></table> 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. The pressure transmitter is an integral part of the stack gas flow meter. Calibration is performed according to QAL2 and AST together with the stack gas flow meter.
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 and therefore not reported.

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:	803,339
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

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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. All values are rounded while exact numbers have been used in the according Excel-calculation.

(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 until

31/12/2012 and 298 tCO_2e thereafter)

Sample calculations for 2012:

2012	P_{NA}	$EF_{BL,N2O,n}$	GWP_{N2O}	
180,890	149,619	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

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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. . All values are rounded while exact numbers have been used in the according Excel-calculation.

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	$PE_{N2O,n}$	$PE_{CO2,tertiary,n}$

5206.80	2397.16	2809.64

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]

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

Sample calculation for 2012:

$PE_{N2O,2012}$	$Q_{N2O,tail\ gas,2012}$	$Q_{N2O,by\text{-}pass,2012}$	GWP_{N2O}
91.10	0.29	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 Standard EN 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

[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 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.

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 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:

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

With:

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

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)[4]

$v_{i,t,db}$ = 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 for 2012:

$F_{i,t}$	$V_{t,db}$	$v_{i,t,db}$	$\rho_{i,t}$
0.121	183,001	0.0000003	1.964

[4] Please note that units are presented according to the applied methodology and tools. Here and forthcoming all m^3 units are referring to m^3.in standard conditions.

Sample calculation for equation (6)*:*

$\rho_{i,t}$	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:

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

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 30/11/2012 17:00:

$V_{t,db}$	$V_{t,wb}$	**1 +** $v_{H2O,t,db}$
175,470	175,470	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):

$$v_{H2O,t,db} = \frac{m_{H2O,t,db} * MM_{t,db}}{MM_{H2O}} \quad (8)$$

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 in 0 as applied in equation (7).

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

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

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 values for 2012:

$Q_{N2O,tail gas,2012}$	$\sum F_{N2O,tail gas,h}$	
0.29	293.87	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. However, no by-pass is installed in the present project activity.

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

Where:

$Q_{N2O,by-pass;n}$ = 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 of 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 values for 2012:

$Q_{N2O,by-pass,2012}$	$EF_{BL,N2O,2012}$	P_{NA}	$T_{open,2012}$	
0.00	3.90	149,619	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 $PE_{FC,i,y}$ used in the tool corresponds to the parameter $PE_{FF,n}$ in the applied methodology.

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

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 values of 2012 (except $COEF_{i,n}$ which is for the whole monitoring period:

$PE_{CO2,tertiary,2012}$	$\sum FC_{i,j,2012}$	$COEF_{i,n}$
564.24	205.05	2.752

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:

$COEF_{i,n}$	$w_{C,i,y}$	
2.752	0.750	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	71.94
M_{C2H6}	30.07	g/mol	0.21
M_{CO2}	44.01	g/mol	10.00

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

Item	Baseline emissions or baseline net GHG removals by sinks (t CO_2e)	Project emissions or actual net GHG removals by sinks (t CO_2e)	Leakage (t CO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO_2e)
Total	808,548	5,209	0	803,339

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)	913,182	803,339

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

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Not applicable.

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)	180,223	623,106

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Document information

Version	*Date*	*Description*
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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