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

MONITORING REPORT

Title of the project activity	Catalytic N2O destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp.
Reference number of the project activity	0765
Version number of the monitoring report	Version 1
Completion date of the monitoring report	15/10/2012
Registration date of the project activity	22/01/2007
Monitoring period number and duration of this monitoring period	Monitoring period number: 23 Duration: 21/09/2012 – 14/10/2012
Project participant(s)	CARBON CDM Korea Ltd. RWE Power AG
Host Party(ies)	Republic of Korea
Sectoral scope(s) and applied methodology(ies)	Scope: 5 - Chemical industries Applied baseline and monitoring methodology: AM0028, Version 1: "Catalytic N_2O destruction in the tail gas of Nitric Acid Plants"
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	One year: 1,280,429 tCO_2e → Monitoring period (24 days): 84,193 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	Monitoring period (24 days): 107,684 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

>>

(a) Carbon CDM Korea has implemented a project for GHG emission reduction by catalytic N_2O destruction in Yeosu, Republic of Korea. The project is categorized as large scale project under sectoral scope 5: "Chemical Industry". The Host Party for the project activity is the Republic of Korea. The Project Activity includes development, design, engineering, procurement, finance, construction, operation and maintenance of a system for catalytic reduction of N_2O in three Nitric Acid Plants (Hu-Chems II; Hu-Chems III; Hu-Chems IV) at Hu-Chems Fine Chemical Corp.

(b) In this project, CARBON CDM Korea installed three EnviNOx® systems for catalytic reduction and decomposition of NO_x and N_2O additionally to the equipment at the three nitric acid manufacturing plants. The project activity reduces the GHG emissions, which would otherwise be released to the atmosphere, if the project was not implemented.
The EnviNOx® process used in the **Hu-Chems II + III** nitric acid plants is based on the catalytic reduction of NO_x (NO and NO_2) with ammonia (NH_3) and of nitrous oxide (N_2O) with a hydrocarbon. The hydrocarbon used is propane gas of which the main constituent is propane (C_3H_8). The reactions take place over an iron zeolite catalyst bed.
The EnviNOx® process used in the **Hu-Chems IV** nitric acid plant is based on the catalytic decomposition of nitrous oxide (N_2O) and the catalytic reduction of NO_x (NO and NO_2) with ammonia (NH_3). This process works very well at temperatures above about 425°C. The reactions take place over two iron zeolite catalyst beds.

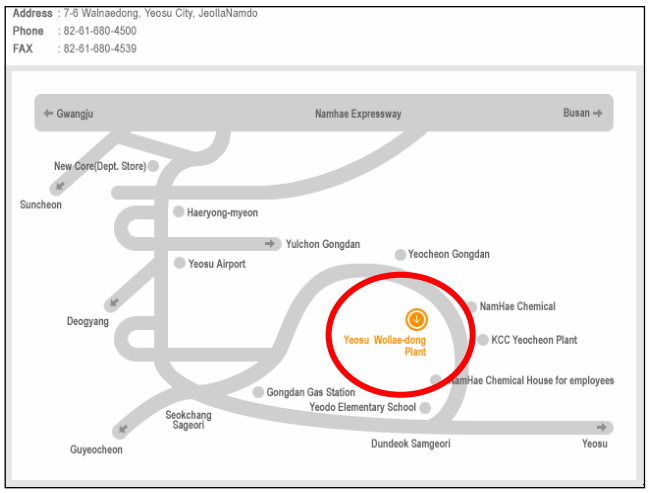
(c) The EnviNOx® system at Hu-Chems IV was installed in December 2006 and the catalytic reduction process of N_2O started in the beginning of January 2007.
The EnviNOx® system at Hu-Chems II and Hu-Chems III was installed in February and March 2007 and the catalytic reduction process of N_2O started in the end of March 2007.

(d) Total emission reductions achieved in this monitoring period: **107,684 tCO_2e**

A.2. Location of project activity

>>

Country: Republic of Korea
Province: Jeollanam-do
Town: Yeosu
GPS coordinates: N34.848686° E127.743198°



The production site of Hu-Chems is located in Yeosu (southern coast of the republic of Korea) in the second biggest industrial complex of Korea consisting of oil, petrochemical, chemical and steel industry.

Hu-Chems is situated on the shores of the Yellow Sea. The company has road and rail access as well as a nearby ship loading terminal.

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Korea (Host)	CARBON CDM Korea Ltd.	No
Federal Republic Germany	RWE Power AG	No

Project applicant, developer and sponsor is **CARBON CDM Korea Ltd.** (furthermore called "CARBON"). CARBON CDM KOREA Ltd. is registered under the laws of the Republic of Korea. The company is a subsidiary of CARBON Projektentwicklung GmbH, Austria, and RWE Power AG. It represents a foreign direct investment under the Foreign Investment Promotion Act (FIPA) of Korea. CARBON Projektentwicklung GmbH was founded as a limited liability company located and registered in Austria under Austrian law in order to develop, finance and operate high quality JI/CDM Projects. CARBON Projektentwicklung GmbH has vast experience with CDM-Project development in Africa, Latin America and Asia and is specialized on the catalytic N_2O destruction in the tail gas of nitric acid plants.

The RWE Group is one of Europe's leading integrated electricity and gas companies. **RWE Power AG** is the continental power generation company within the RWE Group and Germany's biggest power producer. RWE Power has a diverse generation portfolio including lignite, hard coal, nuclear energy, gas and renewable sources such as hydro, wind and biomass. RWE invests and participates actively in projects under the Clean Development Mechanism and Joint Implementation. The RWE team combines a track record in global commodities and emissions trading as well as risk management with broad experience and a deep understanding of specific risks inherent in CDM and JI projects.

Host Country is the Republic of Korea. The Republic of Korea ratified the Kyoto Protocol in November 2002. Subsequent to the registration of the Project, Federal Republic Germany has been added as a Party involved in the Project.

Focal point - The project participants agreed that CARBON CDM Korea Ltd. serves as focal point of communication with the Executive Board and the UNFCCC Secretariat.

A.4. Reference of applied methodology

>>

Applied Baseline and Monitoring methodology:

AM0028, Version 1: "Catalytic N_2O destruction in the tail gas of Nitric Acid Plants" [1]

Furthermore, the applied methodology refers to the "Tool for demonstration and assessment of additionality" in its latest version. The tool was used for demonstrating additionality and baseline scenario selection in the PDD, but has not been used after project registration. At the time of requesting registration for this project activity, version 02 (EB22, Annex 08) of the tool was in place. [2]

[1] http://cdm.unfccc.int/methodologies/DB/GYXZY5ONUHEKMD9MCWY52YTTKOWZ3P
[2] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v6.0.0.pdf/history_view

A.5. Crediting period of project activity

>>

Type of crediting period:	Renewable
Starting date of the first crediting period:	22/01/2007
End date of the first crediting period:	21/01/2014
Length of the first crediting period:	7 years (renewable)

Already before this monitoring period, dates regarding first crediting period were changed from:

Expected starting date of first crediting period:	15/12/2006
Expected end date of first crediting period:	14/12/2013

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

>>

(a) Description of the installed technology, technical processes and equipment

General Introduction

Nitrous oxide (N_2O) is an unwanted, invisible and previously neglected by-product of the manufacture of nitric acid. It is formed alongside the main, desired product nitric oxide (NO) during the catalytic oxidation of ammonia in air over noble metal gauzes. The production of nitric acid takes place in three main process steps as indicated by the following reactions:

1. Ammonia (NH_3) combustion to form nitric oxide (NO)[3]:

   $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$ (main reaction 1) **(1)**

   Simultaneously nitrous oxide (N_2O), nitrogen (N) and water (H_2O) are formed as well, in accordance with the following equations:

   $4\ NH_3 + 3\ O_2 \rightarrow 2\ N_2 + 6\ H_2O$ (side reaction 1) **(2)**
   $4\ NH_3 + 4\ O_2 \rightarrow 2\ N_2O + 6\ H_2O$ (side reaction 2) **(3)**

   NO yield mainly depends on pressure and temperature in the ammonia oxidation process and is usually in a range of 95% to 97%.

2. NO is oxidised to nitrogen dioxide (NO_2):

   $2\ NO + O_2 \rightarrow 2\ NO_2$ (main reaction 2) **(4)**

3. (According to the technical process) Absorption of NO_2 in water to form nitric acid (HNO_3):

   $3\ NO_2 + H_2O \rightarrow 2\ HNO_3 + NO$ (main reaction 3) **(5)**
   (NO is oxidised to NO_2 according to main reaction 2)

Description of catalytic reduction process:

Although the term catalytic reduction nowadays has a more general definition in terms of the transfer of electrons, the following definition is sufficient for present purposes: catalytic reduction of N_2O occurs when reactions take place between N_2O and other substances in contact with a catalyst, such that the

[3] Ammonia is reacted with air on noble metal catalyst in the oxidation section of nitric acid plants. Nitric oxide and water are formed in this process according to the above mentioned main equation.

oxygen is removed from the N_2O molecule and forms one or more compounds with other species. The substance or substances that react with N_2O to remove oxygen are termed reducing agent. A general reaction equation for the catalytic reduction of N_2O can be given as:

$$n\ N_2O + x\ RA \rightarrow n\ N_2 + y_1\ P(1)O_A + y_2\ P(2)O_B + ...+ z_1\ Q(1) + z_2\ Q(2) + ... \quad \textbf{(6)}$$

Where RA is a molecule of the reducing agent, $P(1)O_A$, $P(2)O_B$ are the compound formed by reaction with the oxygen of the N_2O and Q(1), Q(2) represent further products of the oxidation reaction, n, x, y_1, y_2, z_1, z_2 are the appropriate stoichiometric coefficients.

Equations reduction N_2O with propane:

$$C_3H_8 + 7\ N_2O \rightarrow 3\ CO + 4\ H_2O + 7\ N_2 \quad \textbf{(7)}$$
or
$$C_3H_8 + 10\ N_2O \rightarrow 3\ CO_2 + 4\ H_2O + 10\ N_2 \quad \textbf{(8)}$$

The definition does not exclude the possibility of side reactions resulting in consumption of reducing agent without any reduction of N_2O, for example with propane:

$$2\ C_3H_8 + 7\ O_2 \rightarrow 6\ CO + 8\ H_2O \quad \textbf{(9)}$$
or
$$C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O \quad \textbf{(10)}$$

Description of catalytic decomposition process:
Catalytic decomposition of N_2O occurs when the N_2O is split into its constituent elements by contact with a catalyst. A catalyst is a material which accelerates the speed of the reaction without itself being transformed or consumed by the reaction.

Overall reaction:

$$2\ N_2O \rightarrow 2\ N_2 + O_2 \quad \textbf{(11)}$$

The products of N_2O decomposition are the substances that result from decomposition reaction (N_2 and O_2).

Project Specific description:

Principles of the EnviNOx® process in plants Hu-Chems II and Hu-Chems III:
The EnviNOx® process used in the Hu-Chems II + III nitric acid plants is based on the catalytic reduction of NO_x (NO and NO_2) with ammonia (NH_3) and of nitrous oxide (N_2O) with a hydrocarbon. The hydrocarbon used is propane gas of which the main constituent is propane (C_3H_8). The reactions take place over an iron zeolite catalyst bed. First the NO_x is reduced with ammonia according to such reactions as:

$$6\ NO_2 + 8\ NH_3 \rightarrow 7\ N_2 + 12\ H_2O \quad \textbf{(12)}$$
$$6\ NO + 4\ NH_3 \rightarrow 5\ N_2 + 6\ H_2O \quad \textbf{(13)}$$
$$NO + NO_2 + 2\ NH_3 \rightarrow 2\ N_2 + 3\ H_2O \quad \textbf{(14)}$$
$$4\ NO + O_2 + 4\ NH_3 \rightarrow 4\ N_2 + 6\ H_2O \quad \textbf{(15)}$$

Effectively almost all the NOx is removed. Some destruction of N_2O also occurs.

Secondly the nitrous oxide is reduced with hydrocarbons over the iron zeolite according to such reactions as:

$$7\ N_2O + C_3H_8 \rightarrow 7\ N_2 + 4\ H_2O + 3\ CO \quad \textbf{(16)}$$

$$10\ N_2O + C_3H_8 \rightarrow 10\ N_2 + 4\ H_2O + 3\ CO_2 \quad \textbf{(17)}$$
$$5\ O_2 + C_3H_8 \rightarrow 4\ H_2O + 3\ CO_2 \quad \textbf{(18)}$$
$$7\ O_2 + 2\ C_3H_8 \rightarrow 8\ H_2O + 6\ CO \quad \textbf{(19)}$$

Similar reactions take place between nitrous oxide and the small quantities of other hydrocarbons such as butane (C_4H_{10}) that are present in the commercial propane used. N_2O reduction by these reactions is much more effective when NO_x is absent. A large proportion of the carbon monoxide that is formed is further oxidised to carbon dioxide over a second EnviCat®-CO / CH catalyst installed in the EnviNOx® reactor downstream of the first catalyst:

$$2\ CO + O_2 \rightarrow 2\ CO_2 \quad \textbf{(20)}$$

All the above reactions are exothermic and cause a temperature rise over the EnviNOx® reactor. Compared with the reduction in greenhouse gas emission achieved by the destruction of N_2O the additional greenhouse gas emissions (CO_2) caused by the use of hydrocarbons in the process are insignificant but are monitored.

Principles of the EnviNOx® process Hu-Chems IV:
The EnviNOx® process used in the Hu-Chems IV nitric acid plant is based on the catalytic decomposition of nitrous oxide (N_2O) and the catalytic reduction of NO_x (NO and NO_2) with ammonia (NH_3). This process works very well at temperatures above about 425°C. The reactions take place over two iron zeolite catalyst beds.
In the first bed N_2O is catalytically decomposed into its elements:

$$2\ N_2O \rightarrow 2\ N_2 + O_2 \quad \textbf{(21)}$$

This rate of this reaction is enhanced by high concentrations of NO_X.
Before the tail gas enters the second catalyst bed, a small quantity of ammonia vapour is added. In the second bed a large part of the NO_x is reduced with ammonia according to such reactions as:

$$6\ NO_2 + 8\ NH_3 \rightarrow 7\ N_2 + 12\ H_2O \quad \textbf{(22)}$$
$$6\ NO + 4\ NH_3 \rightarrow 5\ N_2 + 6\ H_2O \quad \textbf{(23)}$$
$$NO + NO_2 + 2\ NH_3 \rightarrow 2\ N_2 + 3\ H_2O \quad \textbf{(24)}$$
$$4\ NO + O_2 + 4\ NH_3 \rightarrow 4\ N_2 + 6\ H_2O \quad \textbf{(25)}$$

Some further destruction of N_2O also occurs. All the above reactions are exothermic and cause a temperature rise over the EnviNOx® reactor. The consumption of ammonia corresponds to the stoichiometric ratio given in the reaction equations above and does not differ significantly from the consumption of a conventional DeNOx unit.

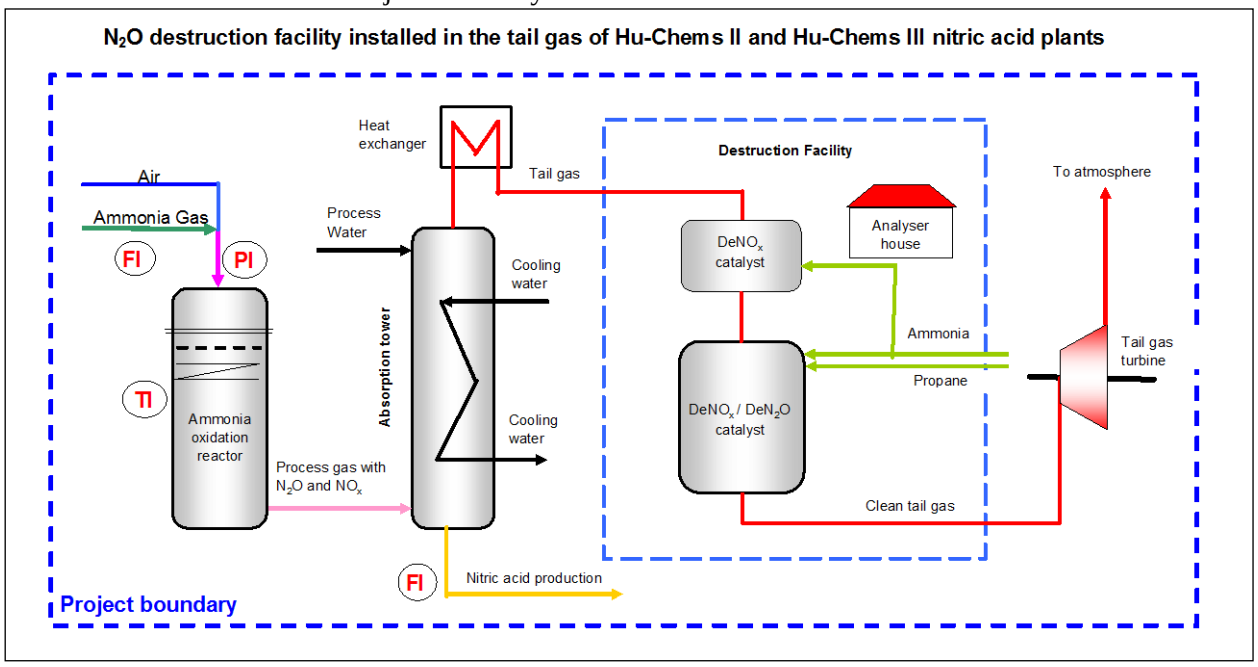
Technology employed by the project activity:
In this project, CARBON CDM Korea installed three EnviNOx® systems for catalytic reduction and decomposition of NOx and N2O additionally to the equipment at the three nitric acid manufacturing plants. The project activity reduces the GHG emissions, which would otherwise be released to the atmosphere, if the project was not implemented. The implementation of the N2O destruction project at Hu-Chems II and Hu-Chems III involves that propane is employed as a reducing agent for N2O removal.

Location of the EnviNOx®-Systems:
Hu-Chems II: The new EnviNOx® reactor (322-R-202) is located between the existing SCR DeNOx reactor (322-R-201) and the tail gas turbine (322-C-201-T2) which is the position with the highest tail gas temperature in the nitric acid production process at Hu-Chems II.

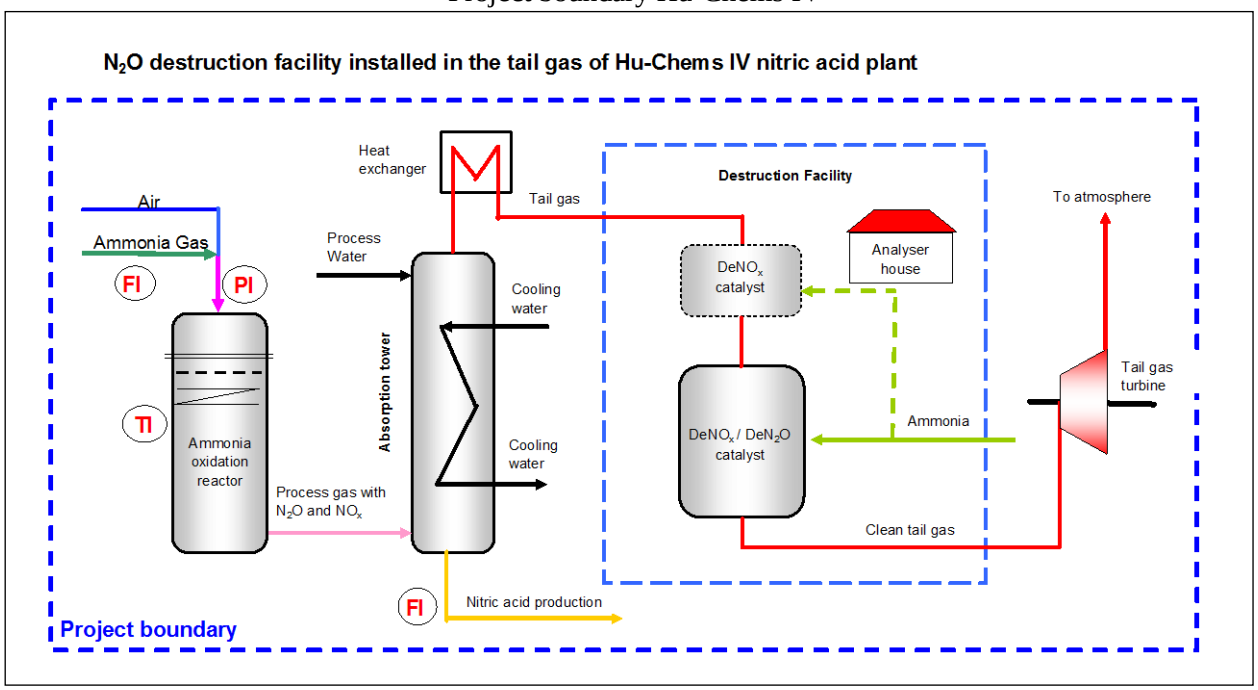
Hu-Chems III: The new EnviNOx® reactor (323-R-302) is located between the existing SCR DeNOx reactor (323-R-301) and the tail gas turbine (323-C-301-T2) of Hu-Chems III which is the position with the highest tail gas temperature in the nitric acid production process at Hu-Chems III.
Hu-Chems IV: The new EnviNOx® reactor (324-R-402) is located upstream of the tail gas turbine (324-C-401-T2) at the position with the highest tail gas temperature in the nitric acid production process at Hu-Chems IV. The priorly operational SCR DeNOx reactor has been de-commissioned.

The following figures show the spatial extent of the project boundary:

Project boundary Hu-Chems II and Hu-Chems III



Project boundary Hu-Chems IV



(b) Implementation status of the project activity during this monitoring period

The project has been fully implemented and is operated as per the registered PDD with all physical features (technology, project equipment, and monitoring and metering equipment) in place, monitoring is done according to the applied methodology (AM0028v1) and the monitoring plan (as per the revision approved by the CDM EB on 18/03/2010).

The project covers three nitric acid plants (three EnviNOx® systems, respectively). The EnviNOx® system at Hu-Chems IV was installed in December 2006, the EnviNOx® systems at Hu-Chems II and Hu-Chems III were installed in February and March 2007. The starting dates of operation of the project activity for each of the plant were as follows:

- Hu-Chems nitric acid plant II: 26 March 2007
- Hu-Chems nitric acid plant III: 29 March 2007
- Hu-Chems nitric acid plant IV: 9 January 2007

(c) Actual operation of the Project Activity during the covered monitoring period

Campaigns of the Nitric Acid Plants

The table below displays the starting dates and end dates of the ammonia oxidation catalyst gauze campaigns of the nitric acid plants. Campaigns start when new gauzes are installed and end, when the gauzes are removed and new gauzes are installed again.

Summary on catalyst gauze campaigns

Nitric Acid plant	**Hu-Chems II**	**Hu-Chems III**	**Hu-Chems IV**
Duration of campaign 1 (=campaign operative at the beginning of the monitoring period)	**Campaign start:** 31/07/2012 **Campaign end:** Ongoing at the end of the Monitoring Period	**Campaign start:** 12/09/2012 **Campaign end:** Ongoing at the end of the Monitoring Period	**Campaign start:** 20/05/2012 **Campaign end:** Ongoing at the end of the Monitoring Period
Duration of campaign 2 (applicable, if new campaign started during monitoring period)	**Not applicable**	**Not applicable**	**Not applicable**

Downtimes of EnviNOx® Systems
During the below mentioned periods, the EnviNOx® Systems were out of operation due to the given reasons. No Emission Reduction is claimed during these downtimes.

Downtimes of the EnviNOx® Systems

EnviNOx® System downtimes					
	Downtime - Start		Downtime - End		Downtime Reason
Plant	Date	Time	Date	Time	Description
IV	05/10/2012	02:00	05/10/2012	23:00	Shutdown of NA Plant (Air compressor trip)

Relevant observations during the monitoring period
During the monitoring period, no abnormal observations related to the operation of the EnviNOx® system and the AMS have been made.

Calibration and Maintenance
The maintenance methods and procedures as well as the calibration scheme for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures, and form an integral part of the systems and procedures of HU-CHEMS. QA/QC of monitoring equipments is in full compliance with the monitoring methodology and the monitoring plan of the registered PDD in its present version (revision approved by the CDM EB on 18/03/2010). Detailed information on exchange and/or calibration of instruments is mentioned under section D – 2.

All measuring and analytical instruments are being calibrated as defined in the Approved Methodology AM0028v1 as well as the monitoring plan in its present version (revision approved by the CDM EB on 18/03/2010) and according to the supplier recommendations (i.e. Emerson Process Management). As pointed out in section C – 3, Carbon CDM Korea has mandated Emerson Process Management Korea to execute additional **regular calibration services** and **regular general maintenance services** to safeguard accuracy and availability of the monitoring instruments related to the CDM Project. Services are adapted to the annual shut-down schedule of the nitric acid plants, valid calibration records for all relevant monitoring instruments are available and submitted to the DOE for verification (Please also see details section D – 2).

As further pointed out in section C – 3, Carbon CDM Korea has contracted Emerson Process Management Korea to execute monthly on-site **Health Checks** and quarterly on-site **Inspection Visits**. System components, sampling system, analysers/measurement devices and the automated monitoring system required for the monitoring of the CDM project are covered by these contracts.
Regular health check and inspection visit services, respectively, have been conducted by Emerson Process Management Korea in September 2012 and attest good condition and availability of the system (i.e. Sampling system, analysers as well as AMS hard- and software and total DeltaV DCS System).

Records of conducted maintenance activities and other performed services related to calibration and maintenance are available and submitted to the DOE for verification.

(d) **Situations with impact on the applicability of the methodology**

No such situations occurred during the covered monitoring period.

B.2. Post registration changes

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

>>

No such temporary deviations have applied to this monitoring period neither to any previous monitoring periods.

B.2.2. Corrections

>>

No such corrections have applied to this monitoring period neither to any previous monitoring periods.

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

>>

No such permanent changes have applied to this monitoring period.

Upon a request by the CDM EB, a revision of the monitoring has been requested in November 2009 and has been approved by the CDM EB on the 18/03/2010 (i.e. before the start of this monitoring period) whereas monitoring of the project is done according to the monitoring plan in this latest approved version. Please note that in case a reference to the "monitoring plan" is made or it is mentioned that a monitoring activity is conducted according to the "monitoring plan", always the latest version, i.e. the revision approved by the CDM EB on the 18/03/2010 is considered to be the "monitoring plan".

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

>>

No such changes have applied to this monitoring period neither to any previous monitoring periods.

B.2.5. Changes to start date of crediting period

>>

No such changes have applied to this monitoring period.

Already before this monitoring period, start date of crediting period has been changed from 15/12/2006 to 22/01/2007.

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

>>

Not applicable to this project activity

SECTION C. Description of monitoring system

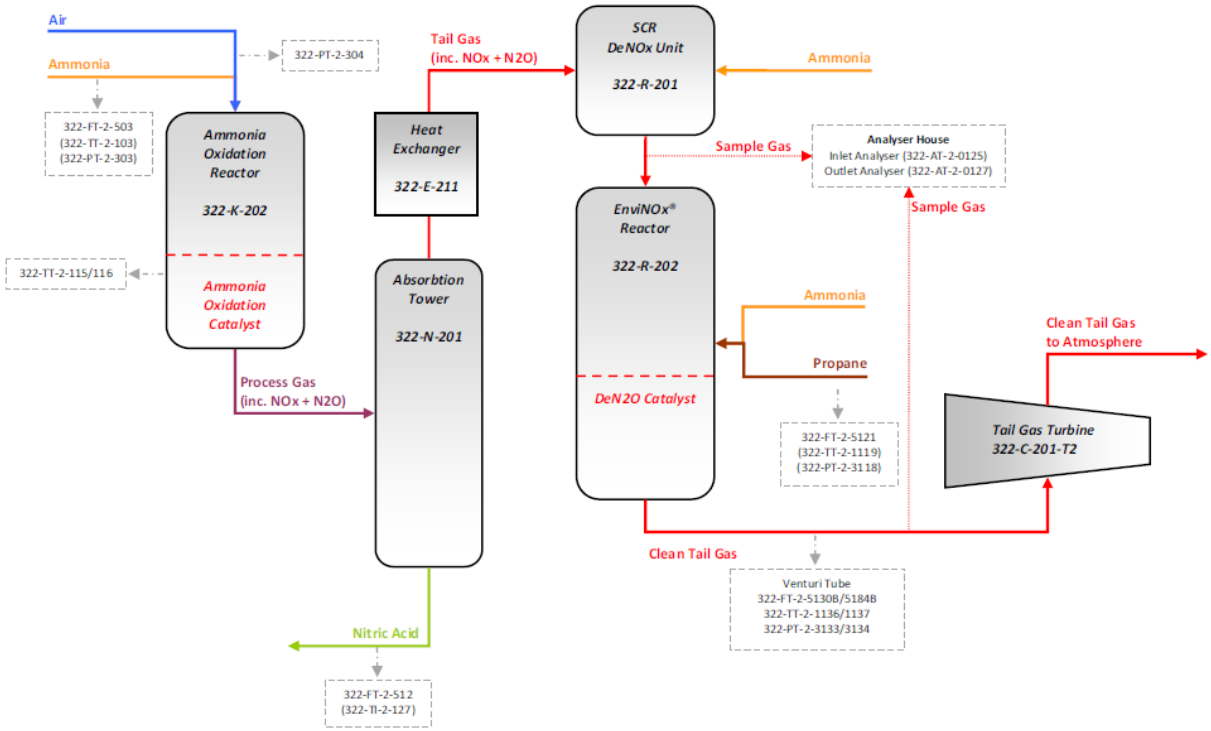
>>

1. Information flow

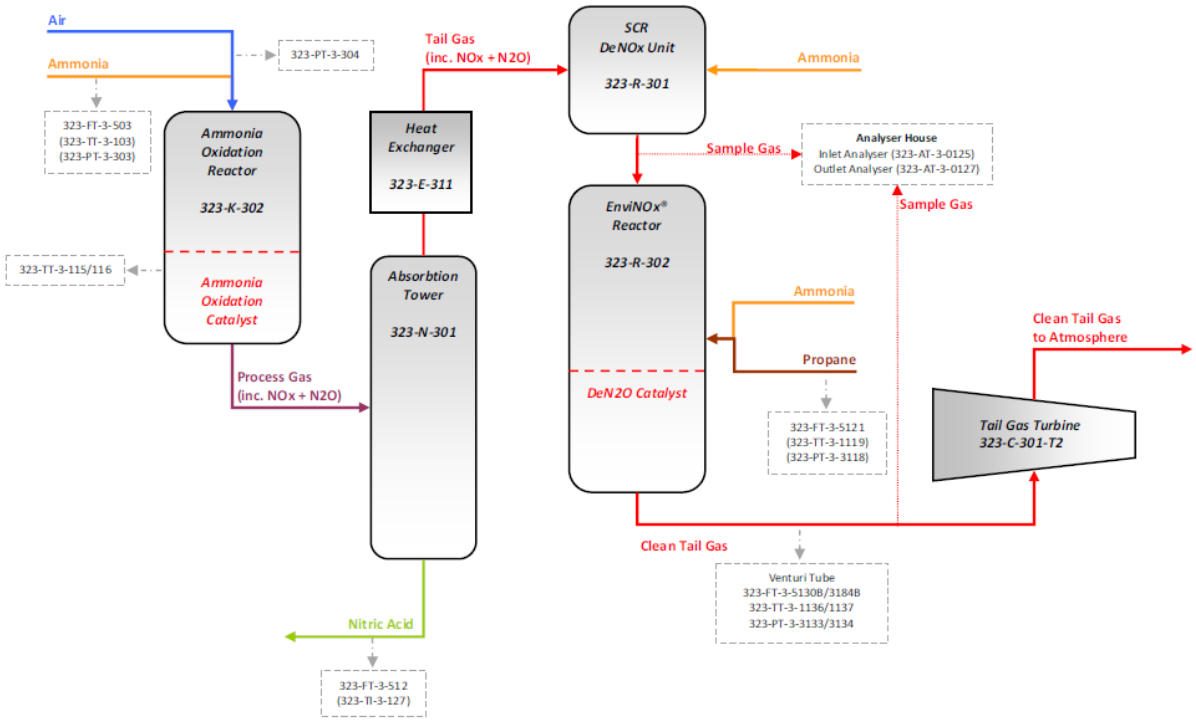
The instruments transmitters continuously provide a 4 - 20 mA analogue signal according to range and units configured. These signals are transmitted to I/O cards (analogue input/output cards) and collected by the DeltaV Processor. Resulting digital values are made available in the network to be further processed (e.g. in controller blocks, calculation of other variables) and are stored as 10 seconds raw data in the protected continuous historian server (CHS).

Modifications of the Delta V, which are protected by security levels by the supplier, are tracked by a Version Control Tool.

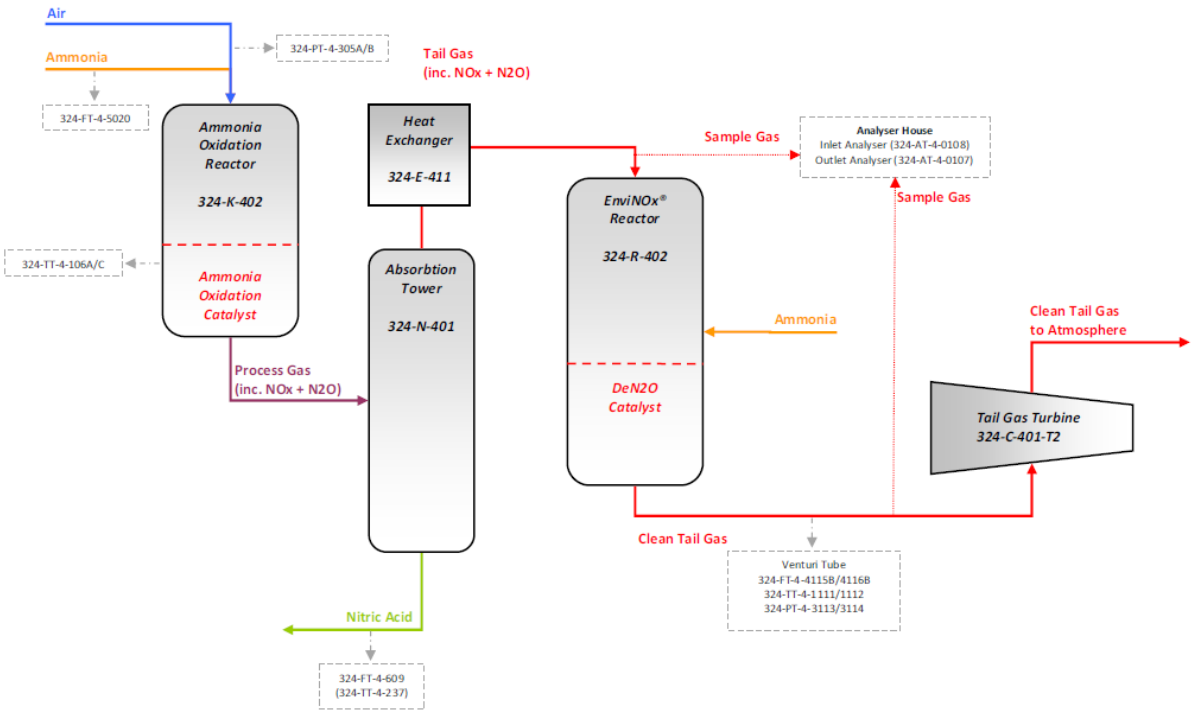
Line-Diagram including the location of the monitoring instruments / Hu-Chems II



Line-Diagram including the location of the monitoring instruments / Hu-Chems III



Line-Diagram including the location of the monitoring instruments / Hu-Chems IV



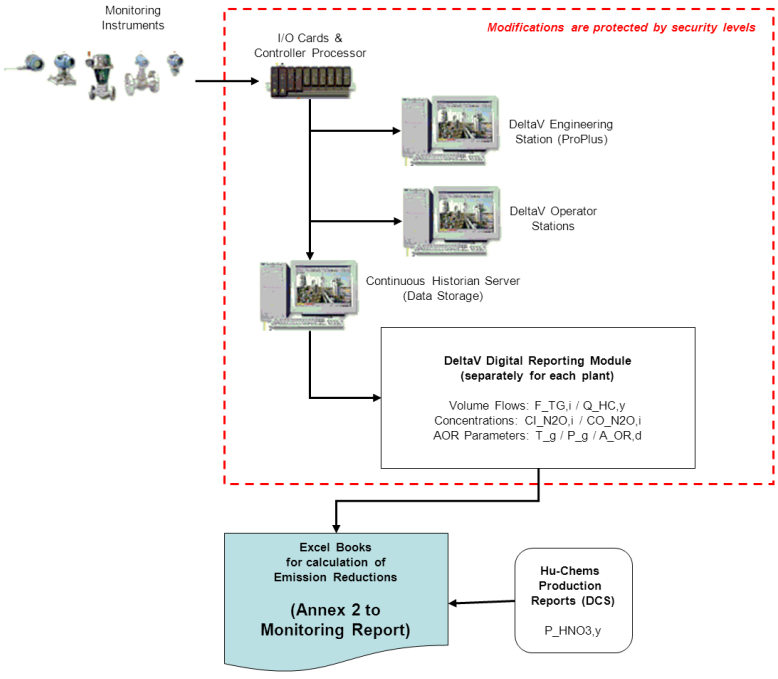
The reporting module of the DeltaV system automatically generates aggregated daily reports (separately for plants Hu-Chems II, Hu-Chems III and Hu-Chems IV) based on the stored raw data from the continuous historian server. Daily reports contain following kinds of data relevant for calculation of claimed emission reductions:

- Concentrations of N_2O at the inlet and outlet of the EnviNOx® systems (CI_N2O,i / CO_N2O,i)
- Volume Flows (F_TG,i / Q_HC,y)
- Operating parameters of the nitric acid plant (T_g, P_g, A_OR,d)

Relevant parameters as above (Concentrations, Volume Flows, Operating parameters of the nitric acid plant) are exported from the digitally available daily reports to excel sheets (separately for each plant, available as *Annex 2* to this monitoring report) for presentation of required parameters and calculation of baseline emissions (BE_y / BE_N2O,y / SE_N2O, QI_N2O,y), project emissions (/PE_y / PE_ND,y / PE_DF,y / PE_HC,y / HCE_C,y, PE_N2O,y), and emission reductions (ER_y) according to formulae as required. The production of nitric acid is recorded by the Hu-Chems DCS of the nitric acid plants. The Hu-Chems DCS automatically generates digital daily reports (separately for each plant), containing the daily production of nitric acid (P_HNO3,y). These parameters are exported from the DCS daily production reports and are digitally transferred to the calculation excel sheets, which are attached as *Annex 2* to this monitoring report.
Details on source of data of all relevant parameters can be found directly in the respective parameter tables in *Section D.*

<u>Special clarification regarding parameters QI_N2O,y and PE_N2O,y</u>
Following the guidance by the CDM Issuance Team related to the incompleteness in the first information and reporting check of the monitoring period 12 (01/01/2010 to 31/03/2010), calculation of the quantity of N_2O at the inlet of the destruction facility (QI_N2O,y) and N_2O not destroyed by the destruction facility (PE_N2O,y) is conducted daily. This calculation is based on recorded daily values (presented in the DeltaV daily reports) of the volume flow (F_TG,i) as well as the concentrations (CI_N2O,i and CO_N2O,i) so that formulae applied are implemented in the excel books (*Annex 2*). Formulae of calculation are shown in the spreadsheet cells for ease of assessment, whenever possible. *The values calculated in these files are used for claiming emission reductions.*

Information flow diagram



The description of the information flow (including data generation, aggregation, recording, calculation and reporting) applies to all plants (Hu-Chems II, Hu-Chems III and Hu-Chems IV). The approach fully complies with the approved Monitoring Methodology AM0028 Version 1 "Catalytic N_2O destruction in the tail gas of Nitric Acid Plants", the registered PDD and the Monitoring Plan (in its present version as approved on 18/03/2010 by the CDM EB), considering additional guidance by the CDM Issuance Team.

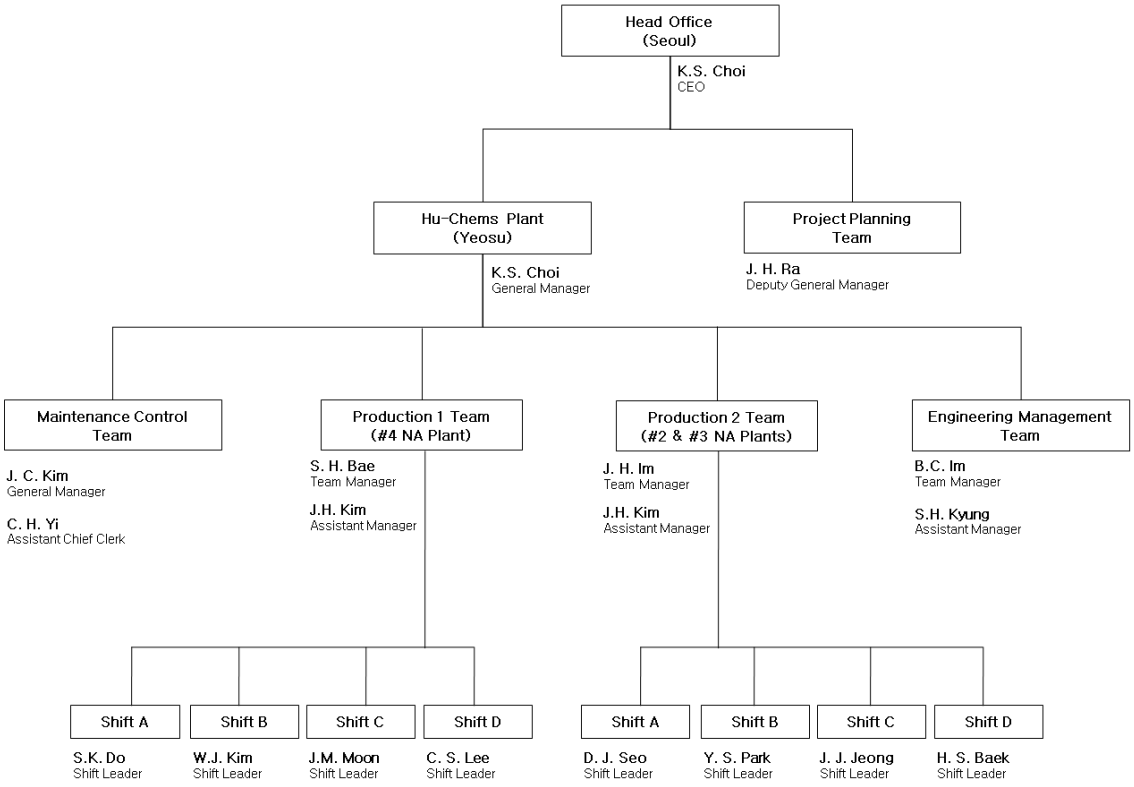
2. Roles and responsibilities of personnel

Project Operator is Hu-Chems Fine Chemical Corp. (HU-CHEMS). HU-CHEMS operates several production units which produce fine chemical products. HU-CHEMS is ISO 9001 and 14001 certified and received the Korean safety and health management system certificate (KGS18001 & OHSAS18001). The company has received the Grand Prize of Korea Valuable Management Award in 2005, the President of Korea's medal in an Energy Saving Promote Contest as well as the Korean Marketing Best Award (KMAC) in 2004 as well as other awards.

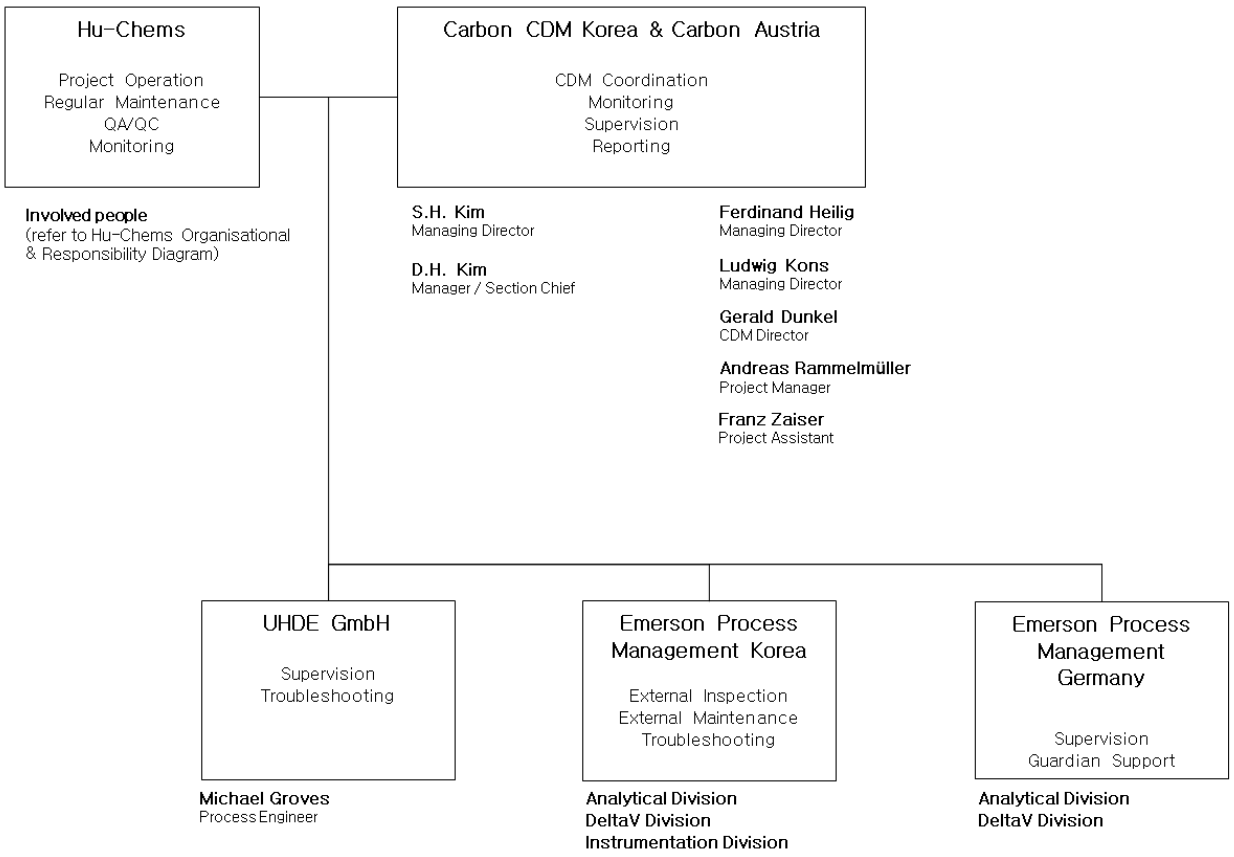
The operating and maintenance personal of the EnviNOx® system have been trained by the technology provider UHDE and the supplier of the digital process control system (Delta V, M/s. process management), further Hu-Chems has established internal training plans on the CDM procedures, operation of the EnviNOx® system and the monitoring system to train staffs who are assigned to the project during the crediting period. Training records are available and submitted to the DOE for verification.

Carbon CDM Korea is responsible for reporting of data under the CDM Project. In terms of performing general supervision and cross-checks of monitoring and reporting data Carbon Austria supports Carbon CDM Korea. Furthermore, Carbon Austria assists Carbon CDM Korea in preparing the CDM-MR and provides additional double-checking of data and information. Carbon Austria gives their final approval on the supporting documents as well as the CDM-MR before submitting to the respective DOE for verification.

Hu-Chems Organisational & Responsibility Diagram



CDM Project: Involved entities & Project responsibilities



3. Back up plans / Emergency procedures for monitoring system

Back Up Plans for measuring systems / Periodically observation of the automated monitoring system

EnviNOx® – Automatic DCS system:

The EnviNOx® systems are designed for automatic operation, so that activities by the operation personnel are not required during normal operation. However, all alarms and any action taken by the operating personnel (events) are automatically logged at the computer station (Alarm & Event List) of the DCS system. All log sheets for **Alarm & Events** are exported and therefore digital available (Excel Files) and can be analysed and evaluated.

Malfunction of system components is indicated on the operator console in the control room as an alarm. Occurrence of such an alarm requires the operator to immediately take measures to remedy the problem. This is done by informing Hu-Chems instrument department and Carbon CDM Korea. It is then deciding whether the problem can be fixed immediately by themselves, or whether external support from Emerson Korea/Emerson Germany/Uhde is required.

Back Up – Regular on-site inspection:

In addition to the automatic error indication by the automatic DCS system, the project operator Hu-Chems is carrying out visual **on-site analyser cabinet inspections** as well as related installations on a shift basis (3 times daily). Relevant data related to the analysers and sampling system are logged on the ISO Document HCSEF-448-1 “CDM Analyzer/Reactor Check List”. Actions are defined in case of abnormal observations.

Further, Hu-Chems is carrying out a **visual on-site check of the EnviNOx® reactor and tail gas line** as well as related installations once per day. Relevant data are logged on the ISO Document HCSEF-448-1 “CDM Analyzer/Reactor Check List”. Actions are defined in case of abnormal observations.

Back Up – System support & Preventive maintenance: DeltaV
The DeltaV automatic measuring system (AMS) used for plant operation & CDM Monitoring was designed by the company Emerson, the overall supplier of components related to the monitoring system.
In order to ensure maximum availability of the DeltaV automatic measuring system and to prevent deficient handling of data, Carbon CDM Korea has contracted Emerson Process Management Korea to execute **monthly** on-site **Health Checks** and **quarterly** on-site **Inspection Visits**. Furthermore a **24 hours emergency service** and the **24 hours DeltaV Guardian Support** are covered by the contract. The contracted services comprise error diagnostics, measures for system stability, updates as well as preventive maintenance for the DeltaV System and related technical components. The contract was coming into force after the start-up period of the project activity. Health check reports and inspection visit reports are available and submitted to the DOE for verification.

Back Up – Support & Preventive maintenance: EnviNOx®-System/Analysers,Instruments
The instruments for CDM Monitoring (i.e. Sampling system and the continuously measuring non-dispersive-infrared (NDIR) analysers used for N_2O detection as well as further instruments) were designed and supplied by the company Emerson Process Management, the general supplier of components related to the monitoring system.

In order to enable high levels of availability and accuracy of instruments, Carbon CDM Korea has contracted Emerson Process Management Korea to execute **monthly** on-site **Health Checks** and **quarterly** on-site **Inspection Visits**. Furthermore a **24 hours emergency service** is covered by the contract. The contracted regular, services comprise error diagnostics of analysers, component updates of the analysers and the sampling system, in-depth inspections of analysers and the sampling system as well as preventive maintenance services for the analysers, the sampling system and technical components/instruments of the CDM Monitoring System. The contract was coming into force after the start-up period of the project activity. Exception handling for CDM Monitoring Instruments is covered by the 24 hours emergency service with guaranteed short-term on-site availability of Emerson experts. Health check reports and inspection visit reports are available and submitted to the DOE for verification.

Supervision is done based on the daily reports by the technology provider Uhde and Emerson.

Back Up – Calibration and General Maintenance: Instruments
In order to safeguard availability and accuracy of instruments, Carbon CDM Korea has mandated Emerson Process Management Korea to execute **regular calibration services** and **regular general maintenance services** for all related monitoring instruments on a regular basis (adapted to the annual shut-down and maintenance schedule of the nitric acid plants). The service inter alia consists, besides calibrations, of hardware and connection maintenance as well as software checks and error diagnostics. Service reports of performed services and calibration records are submitted to the DOE for verification.

Back Up – On-site spare part stock:
As further important contribution to the availability of the monitoring system (e.g. in the event of failure of the measuring equipment), Hu-Chems stores a comprehensive range of spare parts at the project site. The types and amount of stored spare parts meet the recommendations of the supplier. The majority of spare part types are re-purchased after consumption, some other spare part types are re-purchased after their stock has reached a defined reorder level, in both cases Hu-Chems is following the recommendation of the supplier.
The spare part stock includes inter alia filter elements, valves and pressure controllers for the sample handling system and filter elements, analysis cells (crucial part for analyzers), flow sensors and several electrical parts for the analyzers. An overview on available parts is made available to the DOE for verification.

Back Up – Certified standard gases
Pressure levels of standard gases used for the regular, automatic calibration of the inlet and outlet analysers are constantly monitored during the regular on-site inspection. Spare bottles of test gases are purchased in proper time. Specifications and certification of test gases are made available to the DOE for verification.

Back Up – Procedures:
In addition to the quality control and quality assurance procedures according to the Hu-Chems quality management system and in order to avoid possible failures of the automated monitoring system, procedures are implemented for the project activity. The approach by Carbon CDM Korea was to ensure immediate response to such special events in the system.

The following table summarizes the periodical observations of the AMS.

Periodical observation of the AMS

Organization	Action	Frequency	Output
DeltaV	Events & Alarm List	Continuously	Txt-files, Excel files
Hu-Chems	Shift Inspection	3 times per day	Protocol/Check List
Hu-Chems	Daily Inspection	Daily	Protocol/Check List
UHDE	Supervision	Daily	Plausibility check of daily reporting
Emerson Process Management Korea (EPMK)	Health check of AMS System (Hardware & Software)	Monthly	Health Check Report
EPMK	Health Check of Sampling & Analyser system	Monthly	Health Check Report
EPMK	Inspection check of AMS System (Hardware & Software)	Quarterly	Inspection Check Report
EPMK	Inspection check of Sampling & Analyser system	Quarterly	Inspection Check Report
EPMK	General Maintenance & Calibration Service of instruments	Regularly, adopted to annual shut-down schedule of plants	Service Reports & Calibration records

All resulting documents are analysed and evaluated by Carbon CDM Korea under supervision of Carbon Austria. In case of any upcoming problem or failure of the EnviNOx® system and/or the automated monitoring system Carbon CDM Korea immediately takes measure to remedy the problem. The provider of the automated monitoring system is available 24 hours a day via Hotline. Furthermore Emerson Korea is committed to be onsite within 24 hours.

4. Systematic measures for QA for monitoring data during AMS down times

In order to ensure data quality, back up plans (see above) are in place. In case of (scheduled or unscheduled) AMS down times (or parts thereof, such as analysers, etc.), demonstration of normal plant operation and estimation of emission reductions are conducted according to the methodology and the revised monitoring plan. The procedure how to determine the Emissions Reductions during such AMS down times and to ensure suitability and conservativeness is a multi-step approach. Related data and documents are provided to the DOE for verification, if applicable in the covered monitoring period:

(1) Demonstration, that Nitric Acid plant is under normal operation
Suitable operating parameters are provided, in order to demonstrate that the nitric acid plant is operating under normal conditions.

(2) Demonstration, that EnviNO_X® system is under normal operation
Suitable operating parameters are provided, in order to demonstrate that the EnviNO_X® system is operating under normal conditions.

(3) Correlation method
The systematic estimation of a missing parameter is based on correlation methods applying available relevant parameters historically maximally correlating with the missing parameter (e.g. efficiency of the EnviNO_X® system; the flow of N_2O reducing agent to the reactor; the tail gas volume flow, N_2O concentration etc.).

(4) Conservativeness check
Additional conservativeness is ensured by considering limiting values when determining the missing parameter. Such are based upon two representative 24-hour observation periods of operation prior and after the AMS downtime. Project emission parameters are limited to the observed maximum value in the observation periods (and can not fall below this value), baseline emission parameters are limited to the observed minimum value in the observation periods (and can not rise above this value), if missing parameter is fully attributable either to baseline (e.g. inlet concentration) or project emissions (e.g. outlet concentration, hydrocarbon input). In case a missing parameters influences both, baseline and project emissions at the same time (e.g. tail gas flow), the more conservative approach is applied (i.e. leading to least emission reductions during the event period). Given a positive outcome of step (1) and step (2), a 24 hours cycle duly represents regular operation and values are deemed representative.

(5) Recalculation
Determination of emission reductions for hours during AMS downtimes is based on the result of step (3) and step (4) in a conservative way.

This multi-step approach guarantees a conservative estimation of Emissions Reductions during AMS downtimes.

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

Data and parameters fixed ex-ante and NOT MONITORED during monitoring period which are relevant for all three plants (Hu-Chems II, Hu-chems III and Hu-Chems IV)

Data/Parameter	**GWP_N2O**
Unit	tCO_2e/tN_2O
Description	Global warming potential of N_2O
Source of data	According to the PDD / AM0028v1
Value(s) applied	**310 tCO_2e/tN_2O**
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**IPCC default emission factor**
Unit	$tN_2O/tHNO_3$
Description	IPCC default emission factor
Source of data	According to the PDD / AM0028v1
Value(s) applied	**$4.05*10^{-3}$ $tN_2O/tHNO_3$**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data and parameters fixed ex-ante NOT MONITORED during the monitoring period which are specifically relevant for plant Hu-Chems II

Data/Parameter	**EF_HC,II**
Unit	tCO_2/t
Description	Hydrocarbon CO_2 emission factor Hu-Chems II
Source of data	According to the PDD
Value(s) applied	**3.0 tCO_2/t**
Purpose of data	Calculation of project emissions
Additional comment	In Hu-Chems II, propane (C_3H_8) is used as hydrocarbon. The hydrocarbon CO_2 emission factor is given by the molecular weights and the chemical reaction when hydrocarbons are converted (3 tCO_2/tC_3H_8).

Data/Parameter	**OXID_HC,II**
Unit	%
Description	Hydrocarbon oxidation factor Hu-Chems II
Source of data	Value is not monitored, instead conservative option according to the methodology (complete conversion of hydrocarbon (Propane) to CO_2) is applied per default.
Value(s) applied	**100%**
Purpose of data	Calculation of project emissions
Additional comment	Applied assumption of full conversion (OXID_HC,II = 100%) of hydrocarbon (Propane) to CO_2 leads to maximum project emissions theoretically possible from this source in the emission reduction calculation (Conservative approach).

Data/Parameter	**Type_HC,II**
Unit	-
Description	Type of hydrocarbon used in Hu-Chems II
Source of data	According to the PDD
Value(s) applied	**Propane**
Purpose of data	Calculation of project emissions
Additional comment	The EnviNOx® system in Hu-Chems II has been designed to be operated with Propane as reducing agent.

Data/Parameter	**P_HNO3,hist,II**
Unit	t
Description	Design capacity of Hu-Chems II
Source of data	According to PDD
Value(s) applied	**116,800 t**
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**T_g,hist,II**
Unit	°C
Description	Historical operating temperature range of the ammonia oxidation reactor Hu-Chems II
Source of data	According to PDD
Value(s) applied	**880 – 910 °C**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**P_g,hist,II**
Unit	Pa
Description	Historical operating pressure range of the ammonia oxidation reactor Hu-Chems II
Source of data	According to PDD
Value(s) applied	**$5.0*10^5$ to $9.8*10^5$ Pa (equivalent 5.0 to 9.8 barg)**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_sup,hist,II**
Unit	-
Description	Historical supplier of the ammonia oxidation catalyst Hu-Chems II
Source of data	According to PDD
Value(s) applied	**Johnson Matthey** and/or **Umicore**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_com,hist,II**
Unit	%
Description	Historical composition of the ammonia oxidation catalyst Hu-Chems II
Source of data	According to PDD
Value(s) applied	**90% Pt** **5% Rh** **5% Pd**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**A_OR,hist,II**
Unit	tNH_3/day
Description	Max. historical ammonia flow rate to the ammonia oxidation reactor Hu-Chems II
Source of data	According to PDD
Value(s) applied	**91.82 tNH_3/day**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data and parameters fixed ex-ante NOT MONITORED during the monitoring period which are specifically relevant for plant Hu-Chems III

Data/Parameter	**EF_HC,III**
Unit	tCO_2/t
Description	Hydrocarbon CO_2 emission factor Hu-Chems III
Source of data	According to the PDD
Value(s) applied	**3.0 tCO_2/t**
Purpose of data	Calculation of project emissions
Additional comment	In Hu-Chems III, propane (C_3H_8) is used as hydrocarbon. The hydrocarbon CO_2 emission factor is given by the molecular weights and the chemical reaction when hydrocarbons are converted ($3\ tCO_2/tC_3H_8$).

Data/Parameter	**OXID_HC,III**
Unit	%
Description	Hydrocarbon oxidation factor Hu-Chems III
Source of data	Value is not monitored, instead conservative option according to the methodology (complete conversion of hydrocarbon (Propane) to CO_2) is applied per default.
Value(s) applied	**100%**
Purpose of data	Calculation of project emissions
Additional comment	Applied assumption of full conversion (OXID_HC,III = 100%) of hydrocarbon (Propane) to CO_2 leads to maximum project emissions theoretically possible from this source in the emission reduction calculation (Conservative approach).

Data/Parameter	**Type_HC,III**
Unit	-
Description	Type of hydrocarbon used in Hu-Chems III
Source of data	According to the PDD
Value(s) applied	**Propane**
Purpose of data	Calculation of project emissions
Additional comment	The EnviNOx® system in Hu-Chems III has been designed to be operated with Propane as reducing agent.

Data/Parameter	**P_HNO3,hist,III**
Unit	t
Description	Design capacity of Hu-Chems III
Source of data	According to PDD
Value(s) applied	**116,800 t**
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**T_g,hist,III**
Unit	°C
Description	Historical operating temperature range of the ammonia oxidation reactor Hu-Chems III
Source of data	According to PDD
Value(s) applied	**880 – 910 °C**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**P_g,hist,III**
Unit	Pa
Description	Historical operating pressure range of the ammonia oxidation reactor Hu-Chems III
Source of data	According to PDD
Value(s) applied	**$5.0*10^5$ to $9.8*10^5$ Pa (equivalent 5.0 to 9.8 barg)**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_sup,hist,III**
Unit	-
Description	Historical supplier of the ammonia oxidation catalyst Hu-Chems III
Source of data	According to PDD
Value(s) applied	**Johnson Matthey** and/or **Umicore**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_com,hist,III**
Unit	%
Description	Historical composition of the ammonia oxidation catalyst Hu-Chems III
Source of data	According to PDD
Value(s) applied	**90% Pt** **5% Rh** **5% Pd**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**A_OR,hist,III**
Unit	tNH_3/day
Description	Max. historical ammonia flow rate to the ammonia oxidation reactor Hu-Chems III
Source of data	According to PDD
Value(s) applied	**92.57 tNH_3/day**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data and parameters fixed ex-ante NOT MONITORED during the monitoring period which are specifically relevant for plant Hu-Chems IV

Data/Parameter	**P_HNO3,hist,IV**
Unit	t
Description	Design capacity of Hu-Chems IV
Source of data	According to PDD
Value(s) applied	**467,200 t**
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**T_g,hist,IV**
Unit	°C
Description	Historical operating temperature range of the ammonia oxidation reactor Hu-Chems IV
Source of data	According to PDD
Value(s) applied	**860 – 910 °C**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**P_g,hist,IV**
Unit	Pa
Description	Historical operating pressure range of the ammonia oxidation reactor Hu-Chems IV
Source of data	According to PDD
Value(s) applied	**$2.2*10^5$ to $4.4*10^5$ Pa (equivalent 2.2 to 4.4 barg)**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_sup,hist,IV**
Unit	-
Description	Historical supplier of the ammonia oxidation catalyst Hu-Chems IV
Source of data	According to PDD
Value(s) applied	**Johnson Matthey** and/or **Umicore**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_com,hist,IV**
Unit	%
Description	Historical composition of the ammonia oxidation catalyst Hu-Chems IV
Source of data	According to PDD
Value(s) applied	**95% Pt** **5% Rh** and / or **92% Pt** **8% Rh**
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**A_OR,hist,IV**
Unit	tNH_3/day
Description	Max. historical ammonia flow rate to the ammonia oxidation reactor Hu-Chems IV
Source of data	According to PDD
Value(s) applied	**355.50 tNH_3/day**
Purpose of data	Calculation of baseline emissions
Additional comment	-

D.2. Data and parameters monitored

"Annual" or "Yearly" is sometimes mentioned as the "Recording frequency", as it is defined in the methodology (AM0028v1) and the Monitoring Plan and meaning the respective parameter during or related to a year "y". It shall be considered, that "Annual", "Yearly" and the year "y" is understood as the monitoring period covered by this report (21/09/2012 to 14/10/2012), unless otherwise described in a table.

Data and parameters MONITORED during monitoring period which are jointly relevant for all three plants (Hu-Chems II, Hu-chems III and Hu-Chems IV)

Data/Parameter	**BE_y**
Unit	tCO_2e
Description	Baseline emissions
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**110,308 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1 / Monitoring Plan. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**PE_y**
Unit	tCO_2e
Description	Project emissions
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**2,624 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1 / Monitoring Plan. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_ND,y**
Unit	tCO_2e
Description	Project emissions from N_2O not destroyed
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**2,495 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1 / Monitoring Plan. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_DF,y**
Unit	tCO_2e
Description	Project emissions from destruction facility
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**129 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1 / Monitoring Plan. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**REG_NOx**
Unit	tNOx/m³
Description	National regulation on NO_x emissions
Measured/Calculated /Default	Calculated
Source of data	National regulations, Ministry of Environment
Value(s) of monitored parameter	**Provided as 200 ppmv (equivalent to $4.1*10^{-7}$ tNOx / Nm³)** The clean air conservation act (year 1990) limits NOx emissions at nitric acid plants at 200 ppmv (equivalent to $4.1*10^{-7}$ tNOx / Nm³). NO_x emissions are measured at the outlet of the EnviNOx® systems. The continuous measurement of the NO_x concentration reports the following average concentrations over the monitoring period. • Hu-Chems II: 4.3 ppmv (equivalent to $0.09*10^{-7}$ tNOx / Nm³) • Hu-Chems III: 4.0 ppmv (equivalent to $0.08*10^{-7}$ tNOx / Nm³) • Hu-Chems IV: 25.6 ppmv (equivalent to $0.52*10^{-7}$ tNOx / Nm³) Hence, emissions of NOx are well below the allowed limits.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Date of regulation
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**QR_N2O,y**
Unit	tN_2O
Description	Regulation on N_2O emissions (Regulation I: annual quantity N_2O limited)
Measured/Calculated /Default	Calculated
Source of data	National legislation Hu-Chems monitors the legal framework related to emission limits and related to national Korean GHG reduction regimes (following the Framework Act on Low Carbon, Green Growth).
Value(s) of monitored parameter	**No such limit is applicable.** For the covered monitoring period, the Korean national legislation does neither impose a limitation on the quantity of N_2O nor any other type of N_2O emission limit from the Hu-Chems nitric acid plants (Hu-Chems nitric acid plant II, Hu-Chems nitric acid plant III and Hu-Chems nitric acid plant IV).
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Date of regulation

Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**RSE_N2O,y**
Unit	$tN_2O/t\ HNO_3$
Description	Regulation on N_2O emissions (Regulation II: N_2O emissions per unit of nitric acid)
Measured/Calculated /Default	Calculated
Source of data	National legislation Hu-Chems monitors the legal framework related to emission limits and related to national Korean GHG reduction regimes (following the Framework Act on Low Carbon, Green Growth).
Value(s) of monitored parameter	**No such limit is applicable.** For the covered monitoring period, the Korean national legislation does neither impose a limitation on the emissions per unit of nitric acid nor any other type of N_2O emission limit from the Hu-Chems nitric acid plants (Hu-Chems nitric acid plant II, Hu-Chems nitric acid plant III and Hu-Chems nitric acid plant IV).
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Date of regulation
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**CR_N2O**
Unit	tN_2O/m^3
Description	Regulation on N_2O emissions (Regulation III: N_2O concentration in tail gas limited)
Measured/Calculated /Default	Calculated
Source of data	National legislation Hu-Chems monitors the legal framework related to emission limits and related to national Korean GHG reduction regimes (following the Framework Act on Low Carbon, Green Growth).
Value(s) of monitored parameter	**No such limit is applicable.** For the covered monitoring period, the Korean national legislation does neither impose a limitation on the N_2O concentration in the tail gas nor any

	other type of N_2O emission limit from the Hu-Chems nitric acid plants (Hu-Chems nitric acid plant II, Hu-Chems nitric acid plant III and Hu-Chems nitric acid plant IV).
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Date of regulation
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**LE_y**
Unit	tCO_2e
Description	Leakage emissions
Measured/Calculated /Default	-
Source of data	-
Value(s) of monitored parameter	According to AM0028v1, leakage emissions have been excluded in the PDD, as tail gas turbines are installed in all plants, hence **value is zero.** Consequently, parameters usually required by formulae for calculating leakage emissions are not applicable and not monitored.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	-
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of leakage emissions
Additional comment	-

Data and parameters MONITORED during monitoring period which are specifically relevant for plant Hu-Chems II

Data/Parameter	**BE_y,II**
Unit	tCO_2e
Description	Baseline emissions Hu-Chems II
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**27,700 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**PE_y,II**
Unit	tCO_2e
Description	Project emissions Hu-Chems II
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**801 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_ND,y,II**
Unit	tCO_2e
Description	Project emissions from N_2O not destroyed Hu-Chems II
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**740 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_DF,y,II**
Unit	tCO_2e
Description	Project emissions from destruction facility Hu-Chems II
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**61 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_N2O,y,II**
Unit	tN_2O
Description	N_2O not destroyed by facility Hu-Chems II
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**2.386 tN_2O** An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Daily
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report. Furthermore, please refer to the *special clarification regarding parameters QI_N2O,y and PE_N2O,y* under *Section C – 1 (Information Flow)* of this monitoring report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**F_TG,i,II**
Unit	Nm^3/h
Description	Volume flow tail gas at N_2O destruction facility Hu-Chems II
Measured/Calculated /Default	Measured
Source of data	Flow meter (Please refer to monitoring equipment below; Flow metering system automatically records volume flow adjusted to standard temperature and pressure) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**21,763,437 Nm^3** **(37,784 Nm^3/h)** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.

Monitoring equipment	Venturi tube, designed and manufactured in accordance with ISO 5167-4:2003 Meter location: Located in the tail gas line, downstream of the EnviNO_X® reactor (322-R-202). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **322-FT-2-5130B/5184B** Type: Differential pressure transmitters Accuracy class: ± 0.1% of span Serial numbers: 01990156/01990157 Calibration frequency: 24 months Date of last calibrations: 07/05/2012 (Validity: 06/05/2014) **322-TT-2-1136/1137** Type: Temperature transmitters Accuracy class: ± 0.15% of span Serial numbers: 01990158/01990159 Calibration frequency: 24 months Date of last calibrations: 07/05/2012 (Validity: 06/05/2014) **322-PT-2-3133/3134** Type: Pressure transmitters Accuracy class: ± 0.1% of span Serial numbers: 5435394/5435395 Calibration frequency: 24 months Date of last calibrations: 07/05/2012 (Validity: 06/05/2014)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Plausibility check of measured values is regularly done with recorded values of the redundantly installed instruments.
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**CO_N2O,i,II**
Unit	tN_2O/ Nm^3
Description	N_2O concentration at destruction facility outlet Hu-Chems II
Measured/Calculated /Default	Measured
Source of data	Non-dispersive infrared (NDIR) photometry analyser Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**$1.10*10^{-7}$ tN_2O/ Nm^3** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	Meter location: Sample take-off is located in the tail gas line, downstream of the EnviNO_X® reactor (322-R-202), and leads (via sample gas line) to the locked analyser house II (located closely to the EnviNOx® reactor of Hu-Chems plant II), where analysers and standard gases for calibrations are installed. Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **322-AT-2-0127** Type: NDIR Analyzer Accuracy class: ±1% (zero/span) Serial number: 990861497812 Calibration frequency: Zero calibration daily (automatically) Span calibration every two days (automatically) Third party analyser certification frequency by governmental Korean Testing Laboratory (KTL): 24 months Date of last certification: 27/03/2012 (Validity: 26/03/2014)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Accuracy-safeguarding instructions from Emerson Process Management, the manufacturer of the equipment, related to regular self-calibration and quality of used standard gases, are followed.

	The analyzers need a calibration on a regular basis. This adjustment procedure is done automatically and can be triggered manually from the operating console or automatically on a time basis (Zero calibration: daily, span calibration: every two days). Certified (Certificates confirming stability of standard gas during monitoring period and 1% uncertainty) standard gases are used for self calibration. Sample line testing is done annually by applying certified standard gas at the beginning of the sample line. Latest tests have been conducted in June 2012, with positive results. Emerson Process Management Korea has been mandated to conduct monthly analyser health checks and quarterly inspection checks to ensure good instrument condition. Extended general maintenance service by Emerson Process Management Germany has been conducted in March 2012. Plausibility check is regularly done with laboratory gas chromatography analysis.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**M_i,II**
Unit	h
Description	Measuring Interval Hu-Chems II
Measured/Calculated /Default	Measured
Source of data	Data management system (DeltaV)
Value(s) of monitored parameter	**10 sec** Readings/Calculations of relevant parameters are done on a 10 seconds basis. Please also refer to the *special clarification regarding parameters QI_N2O,y and PE_N2O,y* under *Section C – 1 (Information Flow)* of this monitoring report.
Monitoring equipment	Time stamps are generated by the DeltaV system, synchronized by a GPS clock.
Measuring/Reading/ Recording frequency	Measuring: Continuously (N_2O Concentrations and tail gas flow) Reading: Every 10 seconds (N_2O Concentration and tail gas flow) Recording: Daily (N_2O Concentration and tail gas flow)
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems

	Back Up Plans for measuring systems / Periodically observation of the automated monitoring system and *Systematic measures for QA for monitoring data during AMS down times*. Emerson Process Management Korea has been mandated to conduct monthly DeltaV-System health checks and quarterly inspection checks to ensure good system condition and to conduct regular system updates.
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**PE_NH3,y,II**
Unit	tCO_2e
Description	Emissions from ammonia use in destruction facility Hu-Chems II
Measured/Calculated /Default	-
Source of data	-
Value(s) of monitored parameter	Emissions from this source have been excluded in the PDD, as an SCR DeNOx unit has already been installed prior to the project activity, hence **value is zero**. Consequently, parameters usually required by formulae for calculating emissions from ammonia use in the destruction facility (e.g. Q_NH3,y / EF_NH3) are not applicable and not monitored.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	-
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_HC,y,II**
Unit	tCO_2e
Description	Emissions from hydrocarbon use in destruction facility Hu-Chems II
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**61 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)

Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**HCE_C,y,II**
Unit	tCO_2e
Description	Converted hydrocarbon emissions Hu-Chems II
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**61 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**HCE_NC,y,II**
Unit	tCO_2e
Description	Non-converted methane emissions Hu-Chems II
Measured/Calculated /Default	-
Source of data	-
Value(s) of monitored parameter	Propane (no methane) is used as hydrocarbon, hence **value is zero**. Consequently, parameters usually required by formulae for calculating non-converted methane emissions (e.g. Q_HNC,y / ρ_HNC / OXID_CH4 / GWP_CH4) are not applicable and not monitored.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	-
Calculation method (if applicable)	-

QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**Q_HC,y,II**
Unit	Nm^3
Description	Hydrocarbon input (propane as reducing agent) Hu-Chems II
Measured/Calculated /Default	Measured
Source of data	Measuring device (please refer to Monitoring equipment below; Flow metering system automatically records volume flow adjusted to standard temperature and pressure) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**10,020 Nm^3** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	Meter location: Located in the propane gas line, upstream of the EnviNO_X® reactor (322-R-202). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **322-FT-2-5121** Type: Coriolis flow meter Accuracy class: ± 0.35% Serial number: 14126211 Calibration frequency: 60 months Date of last calibration: 02/06/2011 (Validity: 01/06/2016) **322-TT-2-1119** Type: Temperature transmitter Accuracy class: ± 0.15% of span Serial number: 01545263 Calibration frequency: 48 months Date of last calibration: 07/05/2012 (Validity: 06/05/2016) **322-PT-2-3118** Type: Pressure transmitter Accuracy class: ± 0.1% of span Serial number: 5239384 Calibration frequency: 48 months Date of last calibration: 07/05/2012 (Validity: 06/05/2016)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-

QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**ρ_HC,II**
Unit	t / Nm³
Description	Hydrocarbon density Hu-Chems II
Measured/Calculated /Default	Default
Source of data	Default value / Certificate hydrocarbon supplier
Value(s) of monitored parameter	**$2.00*10^{-3}$ t/Nm³** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) For calculation of project emissions, a conservative hydrocarbon density value of $2.00*10^{-3}$ t/Nm³ is applied (as traceable in the excel books, *Annex 2*). According to information available from supplier certificates, actual density of the delivered hydrocarbon is below the applied density of $2.00*10^{-3}$ t/Nm³ for all loads of hydrocarbon delivered. Thus, applied density is conservative.
Monitoring equipment	Composition of the delivered hydrocarbon is measured by the supplier and provided on the specific certificates for each delivered load of hydrocarbon. Based on measured composition available from the hydrocarbon certificate, the actual hydrocarbon density is calculated and compared with the applied default value.
Measuring/Reading/ Recording frequency	Measuring, Reading and Recording frequency for the applied density are not applicable, as a conservative default value is used. However, actual density of delivered load of hydrocarbon is calculated whenever a new load of hydrocarbon (and a respective certificate) is delivered, which usually happens once per month.
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**P_HNO3,y,II**
Unit	$tHNO_3$
Description	Plant output of HNO_3 Hu-Chems II
Measured/Calculated /Default	Measured
Source of data	Production reports The nitric acid produced (recorded as 100% nitric acid) is determined from the volume flow continuously measured with a flow meter, considering nitric acid concentration and density. Required laboratory analysis is conducted three times daily following the respective ISO QM procedure. Daily average of the nitric acid concentration and density are used for calculation of the production of nitric acid for the specific day. The DCS generates daily reports including the daily nitric acid production whereas the data from the daily reports generated by the DCS are transferred to an excel sheet in order to present all parameters as required by AM0028v1 in an overall format.
Value(s) of monitored parameter	**7,073 $tHNO_3$** Nitric Acid produced from 22/01/2011* until 21/01/2012: **80,588** Nitric Acid produced from 22/01/2012* until 14/10/2012: **71,946** Design capacity of the Nitric Acid Plant,according to PDD (P_HNO3,hist,II): **116,800** * The calendar day, on which the crediting period has started is the 22/01/2007, therefore the year between 22/01 of a calendar year and 21/01 of the subsequent calendar year is considered as a "*crediting year*". The nitric acid production within the most recently started crediting year prior to the start of the covered monitoring period is compared with the design capacity of the nitric acid plant as established in the PDD. The produced amount of nitric acid in the completed crediting year between 22/01/2011 until 21/01/2012 has been compared with the design capacity and it was found that the production in the crediting year is clearly below the design capacity. Furthermore, the production in the ongoing crediting year from 22/01/2012 until 14/10/2012 (which is the end of this monitoring period; the end of the crediting year will be the 21/01/2013) was clearly below the design capacity. The assessment duly represents the production within a one-year production cycle. An excel book containing recorded daily values and an automatic check, if the production during the monitoring period is below the designed capacity is attached as *Annex 2* to this Monitoring Report.

Monitoring equipment	Meter location: Located in the nitric acid line, downstream of the absorption tower (322-N-201). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **322-FT-2-512** Type: Magnetic Flowmeter Accuracy class: ± 0.25% Serial number: 0880153845 Calibration frequency: Instrument applied requires no regular calibration after factory calibration Date of factory calibration: 25/05/2009 (Even so, another calibration was performed on 01/06/2011, as part of general calibration activity for all monitoring instruments during the major plant shutdown) General maintenance frequency: 48 months Latest general maintenance: 07/05/2012 (Validity: 06/05/2016) **322-TI-2-127** Type: Temperature Converter Accuracy class: ± 0.15% of span Serial Number: 51305907-175 Calibration frequency: 48 months Date of last calibration: 07/05/2012 (Validity: 06/05/2016)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Plausibility of nitric acid production data is regularly checked by nitrogen balance.
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**BE_N2O,y,II**
Unit	tN_2O
Description	Baseline emissions of N_2O Hu-Chems II
Measured/Calculated /Default	Calculated

Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**89.355 tN_2O** An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Daily
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**QI_N2O,y,II**
Unit	tN_2O
Description	Quantity of N_2O at inlet of destruction facility Hu-Chems II
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**89.355 tN_2O** An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Daily
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report. Furthermore, please refer to the *special clarification regarding parameters QI_N2O,y and PE_N2O,y* under *Section C – 1 (Information Flow)* of this monitoring report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**CI_N2O,i,II**
Unit	tN_2O/ Nm^3
Description	N_2O concentration at N_2O destruction facility inlet Hu-Chems II
Measured/Calculated /Default	Measured
Source of data	Non-dispersive infrared (NDIR) photometry analyser Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**$4.11*10^{-6}$ tN_2O/Nm^3** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	Meter location: Sample take-off is located in the tail gas line, upstream of the EnviNO_X® reactor (322-R-202), and leads (via sample gas line) to the locked analyser house II (located closely to the EnviNOx® reactor of Hu-Chems plant II), where analysers and standard gases for calibrations are installed. Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **322-AT-2-0125** Type: NDIR Analyzer Accuracy class: ±1% (zero/span) Serial number: 370861495671 Calibration frequency: Zero calibration daily (automatically) Span calibration every two days (automatically) Third party analyser certification frequency by governmental Korean Testing Laboratory (KTL): 24 months Date of last certification: 27/03/2012 (Validity: 26/03/2014)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Accuracy-safeguarding instructions from Emerson Process Management, the manufacturer of the equipment, related to regular self-calibration and quality of used standard gases, are followed. The analyzers need a calibration on a regular basis. This adjustment

	procedure is done automatically and can be triggered manually from the operating console or automatically on a time basis (Zero calibration: daily, span calibration: every two days). Certified (Certificates confirming stability of standard gas during monitoring period and 1% uncertainty) standard gases are used for self calibration. Sample line testing is done annually by applying certified standard gas at the beginning of the sample line. Latest tests have been conducted in June 2012, with positive results. Emerson Process Management Korea has been mandated to conduct monthly analyser health checks and quarterly inspection checks to ensure good instrument condition. Extended general maintenance service by Emerson Process Management Germany has been conducted in March 2012. Plausibility check is regularly done with laboratory gas chromatography analysis.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**T_g,II**
Unit	°C
Description	Actual operating temperature ammonia oxidation reactor Hu-Chems II
Measured/Calculated /Default	Measured
Source of data	Measuring device (please refer to Monitoring equipment below) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**Average: 900.0 °C** **Minimum: 899.2 °C** **Maximum: 900.7 °C** The temperature in the ammonia oxidation reactor (AOR) is monitored by two thermocouples. The average operating temperature in the AOR is collected, subsequently the Delta-V system automatically calculates and reports the daily average temperature. An excel book containing daily values and automatic checks, if daily average values are within the permitted range (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report. The actual average daily operating temperature in the AOR is within the permitted range for all days covered by this monitoring period.

Monitoring equipment	Meter location: Located in the ammonia oxidation reactor (322-K-202). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **322-TT-2-115/116** Type: Temperature transmitters Accuracy class: ± 0.15% of span Serial numbers: 1820884 / 1784582 Calibration frequency: 48 months Date of last calibrations: 07/05/2012 (Validity: 06/05/2016)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Continuously (DCS), Daily (Excel books)
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**P_g,II**
Unit	Pa
Description	Actual operating pressure ammonia oxidation reactor Hu-Chems II
Measured/Calculated /Default	Measured
Source of data	Measuring device (please refer to Monitoring equipment below) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**Average: 8.42*10^{5}Pa (equivalent to 8.42 barg)** **Minimum: 8.27*10^{5}Pa (equivalent to 8.27 barg)** **Maximum: 8.59*10^5 Pa (equivalent to 8.59 barg)** The pressure in the ammonia oxidation reactor (AOR) is monitored by a pressure transmitter. The pressure in the AOR is collected and subsequently the Delta-V system automatically reports the daily average pressure. An excel book containing daily values and automatic checks, if daily values are within the permitted range (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report. The actual average daily operating pressure in the AOR is within the permitted range for all days covered by this monitoring period.

Monitoring equipment	Meter location: Located in the air compressor discharge line, upstream of the ammonia oxidation reactor (322-K-202). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **322-PT-2-304** Type: Pressure transmitter Accuracy class: ± 0.25% of span Serial number: 1094015 Calibration frequency: 48 Months Date of last calibration: 07/05/2012 (Validity: 06/05/2016)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Continuously (DCS), Daily (Excel books)
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_sup,II**
Unit	-
Description	Supplier of the ammonia oxidation catalyst Hu-Chems II
Measured/Calculated /Default	-
Source of data	Supplier information (i.e. commercial invoice)
Value(s) of monitored parameter	**Johnson Matthey** The supplier of the ammonia oxidation catalyst is the same as prior to the start of the project activity.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Every gauze change Latest gauze changes, relevant to the monitoring period: 31/07/2012
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_com,II**
Unit	%
Description	Composition of the ammonia oxidation catalyst Hu-Chems II
Measured/Calculated /Default	-
Source of data	Supplier information (i.e. commercial invoice)
Value(s) of monitored parameter	**90% Pt** **5% Rh** **5% Pd** The composition of the ammonia oxidation catalyst during the whole monitoring period is the same kind of catalyst composition already in use prior to the start of the project activity.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Every gauze change (this comprises the date of changing gauze composition, if applicable) Latest gauze changes, relevant to the monitoring period: 31/07/2012
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**SE_N2O,II**
Unit	$tN_2O/tHNO_3$
Description	N_2O emission rate per ton of nitric acid Hu-Chems II
Measured/Calculated /Default	Calculated
Source of data	Monitoring report (i.e. *Annex 2* to this Monitoring Report) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**0.0126 $tN_2O/tHNO_3$**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Yearly (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.

Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**A_OR,d,II**
Unit	tNH_3/day
Description	Actual ammonia flow rate to the ammonia oxidation reactor Hu-Chems II
Measured/Calculated /Default	Measured
Source of data	Measuring device (please refer to Monitoring equipment below) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**Average: 82.77 tNH_3/day** **Minimum: 82.22 tNH_3/day** **Maximum: 83.37 tNH_3/day** An excel book containing daily values and automatic checks, if daily values are below historical maximum ammonia flow rate to the AOR (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report. The actual daily ammonia flow rate to the AOR is below the historical maximum ammonia flow rate to the AOR for all days covered by this monitoring period.
Monitoring equipment	Meter location: Located in the ammonia supply line, upstream of the ammonia oxidation reactor (322-K-202). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **322-FT-2-503** Type: Differential pressure transmitter Accuracy class: ± 0.5% of span Serial number: 2052133 Calibration frequency: 48 Months Date of last calibration: 07/05/2012 (Validity: 06/05/2016) **322-TT-2-103** Type: Temperature transmitter Accuracy class: ± 0.15% of span Calibration frequency: 48 Months Serial number: 1784187 Date of last calibration: 07/05/2012 (Validity: 06/05/2016) **322-PT-2-303** Type: Pressure transmitter Accuracy class: ± 0.1% of span Serial number: 2052135 Calibration frequency: 48 Months Date of last calibration: 07/05/2012 (Validity: 06/05/2016)

Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Continuously (DCS), Daily (Excel books)
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Plausibility of ammonia input data is regularly checked by nitrogen balance.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data and parameters MONITORED during monitoring period which are specifically relevant for plant Hu-Chems III

Data/Parameter	**BE_y,III**
Unit	tCO_2e
Description	Baseline emissions Hu-Chems III
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**24,342 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**PE_y,III**
Unit	tCO_2e
Description	Project emissions Hu-Chems III
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**524 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_ND,y,III**
Unit	tCO_2e
Description	Project emissions from N_2O not destroyed Hu-Chems III
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**456 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_DF,y,III**
Unit	tCO_2e
Description	Project emissions from destruction facility Hu-Chems III
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**68 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_N2O,y,III**
Unit	tN_2O
Description	N_2O not destroyed by facility Hu-Chems III
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**1.471 tN_2O** An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Daily
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report. Furthermore, please refer to the *special clarification regarding parameters QI_N2O,y and PE_N2O,y* under *Section C – 1 (Information Flow)* of this monitoring report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**F_TG,i,III**
Unit	Nm^3/h
Description	Volume flow tail gas at N_2O destruction facility Hu-Chems III
Measured/Calculated /Default	Measured
Source of data	Flow meter (Please refer to monitoring equipment below; Flow metering system automatically records volume flow adjusted to standard temperature and pressure) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**23,335,818 Nm^3** **(40,514 Nm^3/h)** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.

Monitoring equipment	Venturi tube, designed and manufactured in accordance with ISO 5167-4:2003 Meter location: Located in the tail gas line, downstream of the EnviNO_X® reactor (323-R-302). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **323-FT-3-5130B/3184B** Type: Differential pressure transmitters Accuracy class: ± 0.1% of span Serial numbers: 01885789 / 01885790 Calibration frequency: 24 months Date of last calibrations: 24/04/2012 (Validity: 23/04/2014) **323-TT-3-1136/1137** Type: Temperature transmitters Accuracy class: ± 0.15% of span Serial numbers: 01885793 / 01885794 Calibration frequency: 24 months Date of last calibrations: 24/04/2012 (Validity: 23/04/2014) **323-PT-3-3133/3134** Type: Pressure transmitters Accuracy class: ± 0.1% of span Serial numbers: 5389822 / 01993892 Calibration frequency: 24 months Date of last calibrations: 24/04/2012 (Validity: 23/04/2014)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Plausibility check of measured values is regularly done with recorded values of the redundantly installed instruments.
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**CO_N2O,i,III**
Unit	tN_2O/ Nm^3
Description	N_2O concentration at destruction facility outlet Hu-Chems III
Measured/Calculated /Default	Measured
Source of data	Non-dispersive infrared (NDIR) photometry analyser Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**$6.30*10^{-8}$ tN_2O / Nm^3** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	Meter location: Sample take-off is located in the tail gas line, downstream of the $EnviNO_X$® reactor (323-R-302), and leads (via sample gas line) to the locked analyser house III (located closely to the EnviNOx® reactor of Hu-Chems plant III), where analysers and standard gases for calibrations are installed. Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **323-AT-3-0127** Type: NDIR Analyzer Accuracy class: ±1% (zero/span) Serial number: 990861497815 Calibration frequency: Zero calibration daily (automatically) Span calibration every two days (automatically) Third party analyser certification frequency by governmental Korean Testing Laboratory (KTL): 24 months Date of last certification: 27/03/2012 (Validity: 26/03/2014)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Accuracy-safeguarding instructions from Emerson Process Management, the manufacturer of the equipment, related to regular self-calibration and quality of used standard gases, are followed.

	The analyzers need a calibration on a regular basis. This adjustment procedure is done automatically and can be triggered manually from the operating console or automatically on a time basis (Zero calibration: daily, span calibration: every two days). Certified (Certificates confirming stability of standard gas during monitoring period and 1% uncertainty) standard gases are used for self calibration. Sample line testing is done annually by applying certified standard gas at the beginning of the sample line. Latest tests have been conducted in June 2012, with positive results. Emerson Process Management Korea has been mandated to conduct monthly analyser health checks and quarterly inspection checks to ensure good instrument condition. Extended general maintenance service by Emerson Process Management Germany has been conducted in March 2012. Plausibility check is regularly done with laboratory gas chromatography analysis.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**M_i,III**
Unit	h
Description	Measuring Interval Hu-Chems III
Measured/Calculated /Default	Measured
Source of data	Data management system (DeltaV)
Value(s) of monitored parameter	**10 sec** Readings/Calculations of relevant parameters are done on a 10 seconds basis. Please also refer to the *special clarification regarding parameters QI_N2O,y and PE_N2O,y* under *Section C – 1 (Information Flow)* of this monitoring report.
Monitoring equipment	Time stamps are generated by the DeltaV system, synchronized by a GPS clock.
Measuring/Reading/ Recording frequency	Measuring: Continuously (N_2O Concentrations and tail gas flow) Reading: Every 10 seconds (N_2O Concentration and tail gas flow) Recording: Daily (N_2O Concentration and tail gas flow)
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS.

	Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Emerson Process Management Korea has been mandated to conduct monthly DeltaV-System health checks and quarterly inspection checks to ensure good system condition and to conduct regular system updates.
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**PE_NH3,y,III**
Unit	tCO_2e
Description	Emissions from ammonia use in destruction facility Hu-Chems III
Measured/Calculated /Default	-
Source of data	-
Value(s) of monitored parameter	Emissions from this source have been excluded in the PDD, as an SCR DeNOx unit has already been installed prior to the project activity, hence **value is zero**. Consequently, parameters usually required by formulae for calculating emissions from ammonia use in the destruction facility (e.g. Q_NH3,y / EF_NH3) are not applicable and not monitored.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	-
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_HC,y,III**
Unit	tCO_2e
Description	Emissions from hydrocarbon use in destruction facility Hu-Chems III
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**68 tCO_2e**
Monitoring equipment	-

Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**HCE_C,y,III**
Unit	tCO_2e
Description	Converted hydrocarbon emissions Hu-Chems III
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**68 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**HCE_NC,y,III**
Unit	tCO_2e
Description	Non-converted methane emissions Hu-Chems III
Measured/Calculated /Default	-
Source of data	-
Value(s) of monitored parameter	Propane (no methane) is used as hydrocarbon, hence **value is zero**. Consequently, parameters usually required by formulae for calculating non-converted methane emissions (e.g. Q_HNC,y / ρ_HNC / OXID_CH4 / GWP_CH4) are not applicable and not monitored.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	-

Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**Q_HC,y,III**
Unit	Nm^3
Description	Hydrocarbon input (propane as reducing agent) Hu-Chems III
Measured/Calculated /Default	Measured
Source of data	Measuring device (please refer to Monitoring equipment below; Flow metering system automatically records volume flow adjusted to standard temperature and pressure) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**11,325 Nm^3** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	Meter location: Located in the propane gas line, upstream of the EnviNO_X® reactor (323-R-302). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **323-FT-3-5121** Type: Coriolis flow meter Accuracy class: ± 0.35% Serial number: 14125454 Calibration frequency: 60 months Date of last calibration: 02/06/2011 (Validity: 01/06/2016) **323-TT-3-1119** Type: Temperature transmitter Accuracy class: ± 0.15% of span Serial number: 01545265 Calibration frequency: 48 months Date of last calibration: 24/04/2012 (Validity: 23/04/2016) **323-PT-3-3118** Type: Pressure transmitter Accuracy class: ± 0.1% of span Serial number: 5239388 Calibration frequency: 48 months Date of last calibration: 24/04/2012 (Validity: 23/04/2016)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily

Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**ρ_HC,III**
Unit	t / Nm³
Description	Hydrocarbon density Hu-Chems III
Measured/Calculated /Default	Default
Source of data	Default value / Certificate hydrocarbon supplier
Value(s) of monitored parameter	**$2.00*10^{-3}$ t/Nm³** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) For calculation of project emissions, a conservative hydrocarbon density value of $2.00*10^{-3}$ t/Nm³ is applied (as traceable in the excel books, *Annex 2*). According to information available from supplier certificates, actual density of the delivered hydrocarbon is below the applied density of $2.00*10^{-3}$ t/Nm³ for all loads of hydrocarbon delivered. Thus, applied density is conservative.
Monitoring equipment	Composition of the delivered hydrocarbon is measured by the supplier and provided on the specific certificates for each delivered load of hydrocarbon. Based on measured composition available from the hydrocarbon certificate, the actual hydrocarbon density is calculated and compared with the applied default value.
Measuring/Reading/ Recording frequency	Measuring, Reading and Recording frequency for the applied density are not applicable, as a conservative default value is used. However, actual density of delivered load of hydrocarbon is calculated whenever a new load of hydrocarbon (and a respective certificate) is delivered, which usually happens once per month.
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**P_HNO3,y,III**
Unit	$tHNO_3$
Description	Plant output of HNO_3 Hu-Chems III
Measured/Calculated /Default	Measured
Source of data	Production reports The nitric acid produced (recorded as 100% nitric acid) is determined from the volume flow continuously measured with a flow meter, considering nitric acid concentration and density. Required laboratory analysis is conducted three times daily following the respective ISO QM procedure. Daily average of the nitric acid concentration and density are used for calculation of the production of nitric acid for the specific day. The DCS generates daily reports including the daily nitric acid production whereas the data from the daily reports generated by the DCS are transferred to an excel sheet in order to present all parameters as required by AM0028v1 in an overall format.
Value(s) of monitored parameter	**7,169 $tHNO_3$** Nitric Acid produced from 22/01/2011* until 21/01/2012: **98,540** Nitric Acid produced from 22/01/2012* until 14/10/2012: **74,753** Design capacity of the Nitric Acid Plant,according to PDD (P_HNO3,hist,III): **116,800** * The calendar day, on which the crediting period has started is the 22/01/2007, therefore the year between 22/01 of a calendar year and 21/01 of the subsequent calendar year is considered as a "*crediting year*". The nitric acid production within the most recently started crediting year prior to the start of the covered monitoring period is compared with the design capacity of the nitric acid plant as established in the PDD. The produced amount of nitric acid in the completed crediting year between 22/01/2011 until 21/01/2012 has been compared with the design capacity and it was found that the production in the crediting year is clearly below the design capacity. Furthermore, the production in the ongoing crediting year from 22/01/2012 until 14/10/2012 (which is the end of this monitoring period; the end of the crediting year will be the 21/01/2013) was clearly below the design capacity. The assessment duly represents the production within a one-year production cycle. An excel book containing recorded daily values and an automatic check, if the production during the monitoring period is below the designed capacity is attached as *Annex 2* to this Monitoring Report.

Monitoring equipment	Meter location: Located in the nitric acid line, downstream of the absorption tower (323-N-301). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **323-FT-3-512** Type: Magnetic Flowmeter Accuracy class: ± 0.25% Serial number: 06011873 Calibration frequency: Instrument applied requires no regular calibration after factory calibration Date of factory calibration: 19/01/2010 (Even so, another calibration was performed on 01/06/2011, as part of general calibration activity for all monitoring instruments during the major plant shutdown) General maintenance frequency: 48 months Last general maintenance: 24/04/2012 (Validity: 23/04/2016) **323-TI-3-127** Type: Temperature Converter Accuracy class: ± 0.15% of span Serial Number: 51309204-125 Calibration frequency: 48 months Date of last calibration: 24/04/2012 (Validity: 23/04/2016)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Plausibility of nitric acid production data is regularly checked by nitrogen balance.
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**BE_N2O,y,III**
Unit	tN_2O
Description	Baseline emissions of N_2O Hu-Chems III
Measured/Calculated /Default	Calculated

Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**78.526 tN_2O** An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Daily
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**QI_N2O,y,III**
Unit	tN_2O
Description	Quantity of N_2O at inlet of destruction facility Hu-Chems III
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**78.526 tN_2O** An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Daily
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report. Furthermore, please refer to the *special clarification regarding parameters QI_N2O,y and PE_N2O,y* under *Section C – 1 (Information Flow)* of this monitoring report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**CI_N2O,i,III**
Unit	tN_2O/ Nm^3
Description	N_2O concentration at N_2O destruction facility inlet Hu-Chems III
Measured/Calculated /Default	Measured
Source of data	Non-dispersive infrared (NDIR) photometry analyser Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**$3.37*10^{-6}$ tN_2O/ Nm^3** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	Meter location: Sample take-off is located in the tail gas line, upstream of the $EnviNO_X$® reactor (323-R-302), and leads (via sample gas line) to the locked analyser house III (located closely to the EnviNOx® reactor of Hu-Chems plant III), where analysers and standard gases for calibrations are installed. Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **323-AT-3-0125** Type: NDIR Analyzer Accuracy class: ±1% (zero/span) Serial number: 370861497814 Calibration frequency: Zero calibration daily (automatically) Span calibration every two days (automatically) Third party analyser certification frequency by governmental Korean Testing Laboratory (KTL): 24 months Date of last certification: 27/03/2012 (Validity: 26/03/2014)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Accuracy-safeguarding instructions from Emerson Process Management, the manufacturer of the equipment, related to regular self-calibration and

	quality of used standard gases, are followed. The analyzers need a calibration on a regular basis. This adjustment procedure is done automatically and can be triggered manually from the operating console or automatically on a time basis (Zero calibration: daily, span calibration: every two days). Certified (Certificates confirming stability of standard gas during monitoring period and 1% uncertainty) standard gases are used for self calibration. Sample line testing is done annually by applying certified standard gas at the beginning of the sample line. Latest tests have been conducted in June 2012, with positive results. Emerson Process Management Korea has been mandated to conduct monthly analyser health checks and quarterly inspection checks to ensure good instrument condition. Extended general maintenance service by Emerson Process Management Germany has been conducted in March 2012. Plausibility check is regularly done with laboratory gas chromatography analysis.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**T_g,III**
Unit	°C
Description	Actual operating temperature ammonia oxidation reactor Hu-Chems III
Measured/Calculated /Default	Measured
Source of data	Measuring device (please refer to Monitoring equipment below) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**Average: 900.4 °C** **Minimum: 900.0 °C** **Maximum: 901.1 °C** The temperature in the ammonia oxidation reactor (AOR) is monitored by two thermocouples. The average operating temperature in the AOR is collected, subsequently the Delta-V system automatically calculates and reports the daily average temperature. An excel book containing daily values and automatic checks, if daily average values are within the permitted range (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report. The actual average daily operating temperature in the AOR is within the permitted range for all days covered by this monitoring period.

Monitoring equipment	Meter location: Located in the ammonia oxidation reactor (323-K-302). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **323-TT-3-115/116** Type: Temperature transmitter Accuracy class: ± 0.15% of span Serial number: 1730211 / 01876612 Calibration frequency: 48 months Date of last calibrations: 24/04/2012 (Validity: 23/04/2016)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Continuously (DCS), Daily (Excel books)
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**P_g,III**
Unit	Pa
Description	Actual operating pressure ammonia oxidation reactor Hu-Chems III
Measured/Calculated /Default	Measured
Source of data	Measuring device (please refer to Monitoring equipment below) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**Average: 8.93*10^{5}Pa (equivalent to 8.93 barg)** **Minimum: 8.75*10^{5}Pa (equivalent to 8.75 barg)** **Maximum: 9.17*10^5 Pa (equivalent to 9.17 barg)** The pressure in the ammonia oxidation reactor (AOR) is monitored by a pressure transmitter. The pressure in the AOR is collected and subsequently the Delta-V system automatically reports the average pressure. An excel book containing daily values and automatic checks, if daily values are within the permitted range (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report. The actual average daily operating pressure in the AOR is within the permitted range for all days covered by this monitoring period.

Monitoring equipment	Meter location: Located in the air compressor discharge line, upstream of the ammonia oxidation reactor (323-K-302). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **323-PT-3-304** Type: Pressure transmitter Accuracy class: ± 0.25% of span Serial number: 720761910698 Calibration frequency: 48 Months Date of last calibration: 24/04/2012 (Validity: 23/04/2016)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Continuously (DCS), Daily (Excel books)
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_sup,III**
Unit	-
Description	Supplier of the ammonia oxidation catalyst Hu-Chems III
Measured/Calculated /Default	-
Source of data	Supplier information (i.e. commercial invoice)
Value(s) of monitored parameter	**Johnson Matthey** The supplier of the ammonia oxidation catalyst is the same as prior to the start of the project activity.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Every gauze change Latest gauze changes, relevant to the monitoring period: 12/09/2012
Calculation method (if applicable)	-

QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_com,III**
Unit	%
Description	Composition of the ammonia oxidation catalyst Hu-Chems III
Measured/Calculated /Default	-
Source of data	Supplier information (i.e. commercial invoice)
Value(s) of monitored parameter	**90% Pt** **5% Rh** **5% Pd** The composition of the ammonia oxidation catalyst during the whole monitoring period is the same kind of catalyst composition already in use prior to the start of the project activity.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Every gauze change (this comprises the date of changing gauze composition, if applicable) Latest gauze changes, relevant to the monitoring period: 12/09/2012
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**SE_N2O,III**
Unit	$tN_2O/tHNO_3$
Description	N_2O emission rate per ton of nitric acid Hu-Chems III
Measured/Calculated /Default	Calculated
Source of data	Monitoring report (i.e. *Annex 2* to this Monitoring Report) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**0.0110 $tN_2O/tHNO_3$**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Yearly (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**A_OR,d,III**
Unit	tNH_3/day
Description	Actual ammonia flow rate to the ammonia oxidation reactor Hu-Chems III
Measured/Calculated /Default	Measured
Source of data	Measuring device (please refer to Monitoring equipment below) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**Average: 83.58 tNH_3/day** **Minimum: 82.72 tNH_3/day** **Maximum: 84.79 tNH_3/day** An excel book containing daily values and automatic checks, if daily values are below historical maximum ammonia flow rate to the AOR (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report. The actual daily ammonia flow rate to the AOR is below the historical maximum ammonia flow rate to the AOR for all days covered by this monitoring period.
Monitoring equipment	Meter location: Located in the ammonia supply line, upstream of the ammonia oxidation reactor (323-K-302). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report.

	323-FT-3-503 Type: Differential pressure transmitter Accuracy class: ± 0.5% of span Serial number: 2052134 Calibration frequency: 48 Months Date of last calibration: 24/04/2012 (Validity: 23/04/2016) **323-TT-3-103** Type: Temperature transmitter Accuracy class: ± 0.15% of span Serial number: 1809794 Calibration frequency: 48 Months Date of last calibration: 24/04/2012 (Validity: 23/04/2016) **323-PT-3-303** Type: Pressure transmitter Accuracy class: ± 0.1% of span Serial number: 2052136 Calibration frequency: 48 Months Date of last calibration: 24/04/2012 (Validity: 23/04/2016)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Continuously (DCS), Daily (Excel books)
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Plausibility of ammonia input data is regularly checked by nitrogen balance.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data and parameters MONITORED during monitoring period which are specifically relevant for plant Hu-Chems IV

Data/Parameter	**BE_y,IV**
Unit	tCO_2e
Description	Baseline emissions Hu-Chems IV
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**58,266 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**PE_y,IV**
Unit	tCO_2e
Description	Project emissions Hu-Chems IV
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**1,299 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_ND,y,IV**
Unit	tCO_2e
Description	Project emissions from N_2O not destroyed Hu-Chems IV
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**1,299 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_DF,y,IV**
Unit	tCO_2e
Description	Project emissions from destruction facility Hu-Chems IV
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**0 tCO_2e**
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Annual (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_N2O,y,IV**
Unit	tN_2O
Description	N_2O not destroyed by facility Hu-Chems IV
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**4.189 tN_2O** An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Daily
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report. Furthermore, please refer to the *special clarification regarding parameters QI_N2O,y and PE_N2O,y* under *Section C – 1 (Information Flow)* of this monitoring report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**F_TG,i,IV**
Unit	Nm^3/h
Description	Volume flow tail gas at N_2O destruction facility Hu-Chems IV
Measured/Calculated /Default	Measured
Source of data	Flow meter (Please refer to monitoring equipment below; Flow metering system automatically records volume flow adjusted to standard temperature and pressure) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**87,852,224 Nm^3** **(158,292 Nm^3/h)** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.

Monitoring equipment	Venturi tube, designed and manufactured in accordance with ISO 5167-4:2003 Meter location: Located in the tail gas line, downstream of the EnviNO_X® reactor (324-R-402). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **324-FT-4-4115B/4116B** Type: Differential pressure transmitters Accuracy class: ± 0.1% of span Serial numbers: 01885787 / 01885788 Calibration frequency: 24 months Date of last calibrations: 30/05/2011 (Validity: 29/05/2013) **324-TT-4-1111/1112** Type: Temperature transmitters Accuracy class: ± 0.15% of span Serial numbers: 01885791 / 01885792 Calibration frequency: 24 months Date of last calibrations: 30/05/2011 (Validity: 29/05/2013) **324-PT-4-3113/3114** Type: Pressure transmitters Accuracy class: ± 0.1% of span Serial numbers: 5389820 / 5389821 Calibration frequency: 24 months Date of last calibrations: 30/05/2011 (Validity: 29/05/2013)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Plausibility check of measured values is regularly done with recorded values of the redundantly installed instruments.
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**CO_N2O,i,IV**
Unit	tN_2O/ Nm^3
Description	N_2O concentration at destruction facility outlet Hu-Chems IV
Measured/Calculated /Default	Measured
Source of data	Non-dispersive infrared (NDIR) photometry analyser Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**$4.77*10^{-8}$ tN_2O/ Nm^3** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	Meter location: Sample take-off is located in the tail gas line, downstream of the EnviNO_X® reactor (324-R-402), and leads (via sample gas line) to the locked analyser house IV (located closely to the EnviNOx® reactor of Hu-Chems plant IV), where analysers and standard gases for calibrations are installed. Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **324-AT-4-0107** Type: NDIR Analyzer Accuracy class: ±1% (zero/span) Serial number: 990861497818 Calibration frequency: Zero calibration daily (automatically) Span calibration every two days (automatically) Third party analyser certification frequency by governmental Korean Testing Laboratory (KTL): 24 months Date of last certification: 28/03/2012 (Validity: 27/03/2014)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Accuracy-safeguarding instructions from Emerson Process Management, the manufacturer of the equipment, related to regular self-calibration and quality of used standard gases, are followed.

	The analyzers need a calibration on a regular basis. This adjustment procedure is done automatically and can be triggered manually from the operating console or automatically on a time basis (Zero calibration: daily, span calibration: every two days). Certified (Certificates confirming stability of standard gas during monitoring period and 1% uncertainty) standard gases are used for self calibration. Sample line testing is done annually by applying certified standard gas at the beginning of the sample line. Latest tests have been conducted in June 2012, with positive results. Emerson Process Management Korea has been mandated to conduct monthly analyser health checks and quarterly inspection checks to ensure good instrument condition. Extended general maintenance service by Emerson Process Management Germany has been conducted in March 2012. Plausibility check is regularly done with laboratory gas chromatography analysis.
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**M_i,IV**
Unit	h
Description	Measuring Interval Hu-Chems IV
Measured/Calculated /Default	Measured
Source of data	Data management system (DeltaV)
Value(s) of monitored parameter	**10 sec** Readings/Calculations of relevant parameters are done on a 10 seconds basis. Please also refer to the *special clarification regarding parameters QI_N2O,y and PE_N2O,y* under *Section C – 1 (Information Flow)* of this monitoring report.
Monitoring equipment	Time stamps are generated by the DeltaV system, synchronized by a GPS clock.
Measuring/Reading/ Recording frequency	Measuring: Continuously (N_2O Concentrations and tail gas flow) Reading: Every 10 seconds (N_2O Concentration and tail gas flow) Recording: Daily (N_2O Concentration and tail gas flow)
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS.

	Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Emerson Process Management Korea has been mandated to conduct monthly DeltaV-System health checks and quarterly inspection checks to ensure good system condition and to conduct regular system updates.
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**PE_NH3,y,IV**
Unit	tCO_2e
Description	Emissions from ammonia use in destruction facility Hu-Chems IV
Measured/Calculated /Default	-
Source of data	-
Value(s) of monitored parameter	Emissions from this source have been excluded in the PDD, as an SCR DeNOx unit has already been installed prior to the project activity, hence **value is zero**. Consequently, parameters usually required by formulae for calculating emissions from ammonia use in the destruction facility (e.g. Q_NH3,y / EF_NH3) are not applicable and not monitored.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	-
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**PE_HC,y,IV**
Unit	tCO_2e
Description	Emissions from hydrocarbon use in destruction facility Hu-Chems IV
Measured/Calculated /Default	-
Source of data	-
Value(s) of monitored parameter	As no hydrocarbon is used, **value is zero**. Consequently, parameters usually required by formulae for calculating emissions from hydrocarbon use in destruction facility (e.g. HCE_C,y / Q_HC,y / ρ_HC / EF_HC / OXID_HC / Type_HC as well as HCE_NC,y / Q_HNC,y / ρ_HNC / OXID_CH4 / GWP_CH4) are not applicable and not monitored.
Monitoring equipment	-

Measuring/Reading/ Recording frequency	-
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of project emissions
Additional comment	-

Data/Parameter	**P_HNO3,y,IV**
Unit	$tHNO_3$
Description	Plant output of HNO_3 Hu-Chems IV
Measured/Calculated /Default	Measured
Source of data	Production reports The nitric acid produced (recorded as 100% nitric acid) is determined from the volume flow continuously measured with a flow meter, considering nitric acid concentration and density. Required laboratory analysis is conducted three times daily following the respective ISO QM procedure. Daily average of the nitric acid concentration and density are used for calculation of the production of nitric acid for the specific day. The DCS generates daily reports including the daily nitric acid production whereas the data from the daily reports generated by the DCS are transferred to an excel sheet in order to present all parameters as required by AM0028v1 in an overall format.
Value(s) of monitored parameter	**28,382 $tHNO_3$** Nitric Acid produced from 22/01/2011* until 21/01/2012: **435,296** Nitric Acid produced from 22/01/2012* until 14/10/2012: **315,301** Design capacity of the Nitric Acid Plant,according to PDD (P_HNO3,hist,IV): **467,200** * The calendar day, on which the crediting period has started is the 22/01/2007, therefore the year between 22/01 of a calendar year and 21/01 of the subsequent calendar year is considered as a "*crediting year*". The nitric acid production within the most recently started crediting year prior to the start of the covered monitoring period is compared with the design capacity of the nitric acid plant as established in the PDD. The produced amount of nitric acid in the completed crediting year between 22/01/2011 until 21/01/2012 has been compared with the design capacity and it was found that the production in the crediting year is clearly below the design capacity. Furthermore, the production in the ongoing crediting year from 22/01/2012 until 14/10/2012 (which is the end of this monitoring period; the end of the crediting year will be the 21/01/2013) was clearly below the design

	capacity. The assessment duly represents the production within a one-year production cycle. An excel book containing recorded daily values and an automatic check, if the production during the monitoring period is below the designed capacity is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	Meter location: Located in the nitric acid line, downstream of the absorption tower (324-N-401). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **324-FT-4-609** Type: Magnetic Flowmeter Accuracy class: ± 0.5% Serial number: 0870173774 Calibration frequency: Instrument applied requires no regular calibration after factory calibration Factory calibration: 26/05/2009 (Even so, another calibration was performed on 30/05/2011, as part of general calibration activity for all monitoring instruments during the major plant shutdown) General maintenance frequency: 48 months Latest general maintenance: 01/06/2011 (Validity: 31/05/2015) **324-TT-4-237** Type: Temperature Transmitter Accuracy class: ± 0.15% of span Serial number: 966595 Calibration frequency: 48 months Date of last calibration: 30/05/2011 (Validity: 29/05/2015)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Plausibility of nitric acid production data is regularly checked by nitrogen balance.
Purpose of data	Calculation of baseline and project emissions
Additional comment	-

Data/Parameter	**BE_N2O,y,IV**
Unit	tN_2O
Description	Baseline emissions of N_2O Hu-Chems IV
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**187.957 tN_2O** An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Daily
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**QI_N2O,y,IV**
Unit	tN_2O
Description	Quantity of N_2O at inlet of destruction facility Hu-Chems IV
Measured/Calculated /Default	Calculated
Source of data	Monitoring system Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**187.957 tN_2O** An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Daily
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report. Furthermore, please refer to the *special clarification regarding parameters QI_N2O,y and PE_N2O,y* under *Section C – 1 (Information Flow)* of this

	monitoring report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**CI_N2O,i,IV**
Unit	tN_2O/ Nm^3
Description	N_2O concentration at N_2O destruction facility inlet Hu-Chems IV
Measured/Calculated /Default	Measured
Source of data	Non-dispersive infrared (NDIR) photometry analyser Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**$2.14*10^{-6}$ tN_2O/ Nm^3** (Standard temperature: 273.15K, standard pressure: 1,013.25 hPa) An excel book containing recorded daily values (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.
Monitoring equipment	Meter location: Sample take-off is located in the tail gas line, upstream of the $EnviNO_X$® reactor (324-R-402), and leads (via sample gas line) to the locked analyser house IV (located closely to the EnviNOx® reactor of Hu-Chems plant IV), where analysers and standard gases for calibrations are installed. Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **324-AT-4-0108** Type: NDIR Analyzer Accuracy class: ±1% (zero/span) Serial number: 370861497817 Calibration frequency: Zero calibration daily (automatically) Span calibration every two days (automatically) Third party analyser certification frequency by governmental Korean Testing Laboratory (KTL): 24 months Date of last certification: 28/03/2012 (Validity: 27/03/2014)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Daily
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the*

	automated monitoring system and *Systematic measures for QA for monitoring data during AMS down times*. Accuracy-safeguarding instructions from Emerson Process Management, the manufacturer of the equipment, related to regular self-calibration and quality of used standard gases, are followed. The analyzers need a calibration on a regular basis. This adjustment procedure is done automatically and can be triggered manually from the operating console or automatically on a time basis (Zero calibration: daily, span calibration: every two days). Certified (Certificates confirming stability of standard gas during monitoring period and 1% uncertainty) standard gases are used for self calibration. Sample line testing is done annually by applying certified standard gas at the beginning of the sample line. Latest tests have been conducted in June 2012, with positive results. Emerson Process Management Korea has been mandated to conduct monthly analyser health checks and quarterly inspection checks to ensure good instrument condition. Extended general maintenance service by Emerson Process Management Germany has been conducted in March 2012. Plausibility check is regularly done with laboratory gas chromatography analysis.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**T_g,IV**
Unit	°C
Description	Actual operating temperature ammonia oxidation reactor Hu-Chems IV
Measured/Calculated /Default	Measured
Source of data	Measuring device (please refer to Monitoring equipment below) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**Average: 880.3 °C** **Minimum: 872.6 °C** **Maximum: 884.2 °C** The temperature in the ammonia oxidation reactor (AOR) is monitored by two thermocouples. The average operating temperature in the AOR is collected, subsequently the Delta-V system automatically calculates and reports the daily average temperature. An excel book containing daily values and automatic checks, if daily average values are within the permitted range (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report.

	The actual average daily operating temperature in the AOR is within the permitted range for all days covered by this monitoring period.
Monitoring equipment	Meter location: Located in the ammonia oxidation reactor (324-K-402). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **324-TT-4-106A/C** Type: Temperature transmitters Accuracy class: ± 0.15% of span Serial numbers: 966596 / 966598 Calibration frequency: 48 months Date of last calibrations: 30/05/2011 (Validity: 29/05/2015)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Continuously (DCS), Daily (Excel books)
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**P_g,IV**
Unit	Pa
Description	Actual operating pressure ammonia oxidation reactor Hu-Chems IV
Measured/Calculated /Default	Measured
Source of data	Measuring device (please refer to Monitoring equipment below) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**Average: $3.61*10^5$ Pa (equivalent to 3.61 barg)** **Minimum: $3.59*10^5$ Pa (equivalent to 3.59 barg)** **Maximum: $3.63*10^5$ Pa (equivalent to 3.63 barg)** The pressure in the ammonia oxidation reactor (AOR) is monitored by two pressure transmitters. The average pressure in the AOR is collected and subsequently the Delta-V system automatically reports the daily average pressure.

	An excel book containing daily values and automatic checks, if daily values are within the permitted range (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report. The actual average daily operating pressure in the AOR is within the permitted range for all days covered by this monitoring period.
Monitoring equipment	Meter location: Located in the air compressor discharge line, upstream of the ammonia oxidation reactor (324-K-402). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **324-PT-4-305A/B** Type: Pressure transmitters Accuracy class: ± 0.1% of span Serial numbers: RS0966518/ RS0966519 Calibration frequency: 48 Months Date of last calibrations: 30/05/2011 (Validity: 29/05/2015)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Continuously (DCS), Daily (Excel books)
Calculation method (if applicable)	-
QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_sup,IV**
Unit	-
Description	Supplier of the ammonia oxidation catalyst Hu-Chems IV
Measured/Calculated /Default	-
Source of data	Supplier information (i.e. commercial invoice)
Value(s) of monitored parameter	**Johnson Matthey** The supplier of the ammonia oxidation catalyst is the same as prior to the start of the project activity.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Every gauze change

	Latest gauze changes, relevant to the monitoring period: 20/05/2012
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**G_com,IV**
Unit	%
Description	Composition of the ammonia oxidation catalyst Hu-Chems IV
Measured/Calculated /Default	-
Source of data	Supplier information (i.e. commercial invoice)
Value(s) of monitored parameter	**95% Pt** **5% Rh** The composition of the ammonia oxidation catalyst during the whole monitoring period is the same kind of catalyst composition already in use prior to the start of the project activity.
Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Every gauze change (this comprises the date of changing gauze composition, if applicable) Latest gauze changes, relevant to the monitoring period: 20/05/2012
Calculation method (if applicable)	-
QA/QC procedures	-
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**SE_N2O,IV**
Unit	$tN_2O/tHNO_3$
Description	N_2O emission rate per ton of nitric acid Hu-Chems IV
Measured/Calculated /Default	Calculated
Source of data	Monitoring report (i.e. *Annex 2* to this Monitoring Report) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**0.0066 $tN_2O/tHNO_3$**

Monitoring equipment	-
Measuring/Reading/ Recording frequency	Measuring: Not applicable Reading: Not applicable Recording: Yearly (please refer to explanation under D.2.)
Calculation method (if applicable)	Calculated according to formulae in AM0028v1. An excel book containing the calculation and a description of the applied formulae is attached as *Annex 2* to this Monitoring Report.
QA/QC procedures	Consistency checks and comparison are conducted by Carbon CDM Korea and Carbon Austria.
Purpose of data	Calculation of baseline emissions
Additional comment	-

Data/Parameter	**A_OR,d,IV**
Unit	tNH_3/day
Description	Actual ammonia flow rate to the ammonia oxidation reactor Hu-Chems IV
Measured/Calculated /Default	Measured
Source of data	Measuring device (please refer to Monitoring equipment below) Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report.
Value(s) of monitored parameter	**Average: 339.81 tNH_3/day** **Minimum: 62.43 tNH_3/day** **Maximum: 354.16 tNH_3/day** An excel book containing daily values and automatic checks, if daily values are below historical maximum ammonia flow rate to the AOR (for all days covered by this monitoring period), is attached as *Annex 2* to this Monitoring Report. The actual daily ammonia flow rate to the AOR is below the historical maximum ammonia flow rate to the AOR for all days covered by this monitoring period.
Monitoring equipment	Meter location: Located in the ammonia supply line, upstream of the ammonia oxidation reactor (324-K-402). Please refer also to *Section C – 1 (Line diagram)* of this Monitoring Report. **324-FT-4-5020** Type: Coriolis flowmeter Accuracy class: ± 0.35% Serial number: 14137655 Calibration frequency: 60 Months Date of last calibration: 30/05/2011 (Validity: 29/05/2016)
Measuring/Reading/ Recording frequency	Measuring: Continuously Reading: Every 10 seconds Recording: Continuously (DCS), Daily (Excel books)
Calculation method (if applicable)	-

QA/QC procedures	The maintenance methods and procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures of HU-CHEMS. Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3). Please refer also to *Section C – 3. Back Up plans / Emergency procedures for monitoring system* of this Monitoring Report and respective subitems *Back Up Plans for measuring systems / Periodically observation of the automated monitoring system* and *Systematic measures for QA for monitoring data during AMS down times*. Plausibility of ammonia input data is regularly checked by nitrogen balance.
Purpose of data	Calculation of baseline emissions
Additional comment	-

D.3. Implementation of sampling plan

>>

No sampling plan is applicable to this project activity.

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

All references to formulae and methods used are in compliance with AM0028v1 and the project documentation (PDD, revised monitoring plan) and are transparently shown in the excel books (Annex 2 to this monitoring report).

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

>>

Baseline emissions of the project activity are determined based on the quantity of N_2O emitted in the baseline scenario (i.e. the quantity at inlet of the destruction facility), taking national regulations, production levels, the operating conditions of the ammonia oxidation reactor (temperature and pressure), the composition of ammonia oxidation catalyst and the ammonia flow rate to the ammonia oxidation reactor into consideration. Following monitoring activities have been done separately for each of the three nitric acid plants (Hu-Chems II, Hu-Chems III and Hu-Chems IV):

- The quantity of N_2O at inlet of destruction facility (QI_N2O,y) is directly calculated by multiplying the measured tail gas volume flow rate and the measured N_2O concentrations;
- It has been monitored, if the there are Korean regulations in place that would limit the quantity of N_2O that can be taken into account for the calculation of baseline emissions;
- It has been monitored, if the production level of HNO_3 for the monitoring period was below the design capacity of the plant;
- It has been monitored, if the operating conditions (temperature and pressure) in the ammonia oxidation reactor were within the permitted ranges for the days in by the monitoring period;
- It has been monitored, if the composition of the ammonia oxidation catalyst gauzes in the ammonia oxidation reactor has been the same as the historical catalyst composition;
- It has been monitored, if the ammonia flow rate to the ammonia oxidation reactor has been below the historical maximum.

Excel books containing recorded monitored data, a comprehensive calculation of baseline emissions with actual values (formulae of calculation are shown in the spreadsheet cells for ease of assessment), automatic checks of nitric acid production levels against design capacity, automatic checks of operating conditions (temperature, pressure) against permitted operating ranges and automatic checks of ammonia flow rates to the ammonia oxidation reactor against the historical maximum are attached as *Annex 2* to this Monitoring Report.

Calculation of total baseline emissions of the project activity
The total baseline emissions of the project activity during the monitoring period (BE_y) are the sum over the plant-specific baseline emissions (BE_y,II / BE_y,III / BE_y,IV):

BE_y = BE_y,II + BE_y,III + BE_y,IV = BE_N2O,y x GWP_N2O **(26)**
BE_N2O,y = BE_N2O,y,II + BE_N2O,y,III + BE_N2O,y,IV **(27)**

Parameter	Unit	Hu-Chems Total
BE_y	**tCO2e**	**110,308**
BE_y,II	tCO2e	27,700
BE_y,III	tCO2e	24,342
BE_y,IV	tCO2e	58,266

Based on formulae (26) and (27) above:
BE_y,II = BE_N2O,y,II x GWP_N2O **(28)**

Parameter	Unit	Hu-Chems II
BE_y,II	**tCO2e**	**27,700**
BE_N2O,y,II	tN2O	89.355
GWP_N2O	tCO2e / tN2O	310

BE_y,III = BE_N2O,y,III x GWP_N2O **(29)**

Parameter	Unit	Hu-Chems III
BE_y,III	**tCO2e**	**24,342**
BE_N2O,y,III	tN2O	78.526
GWP_N2O	tCO2e / tN2O	310

BE_y,IV = BE_N2O,y,IV x GWP_N2O **(30)**

Parameter	Unit	Hu-Chems IV
BE_y,IV	**tCO2e**	**58,266**
BE_N2O,y,IV	tN2O	187.957
GWP_N2O	tCO2e / tN2O	310

where:
BE_y Baseline emissions in year y (tCO_2e)
BE_y,II Baseline emissions Hu-Chems II in year y (tCO_2e)
BE_y,III Baseline emissions Hu-Chems III in year y (tCO_2e)
BE_y,IV Baseline emissions Hu-Chems IV in year y (tCO_2e)
BE_N2O,y Baseline emissions of N_2O in year y (tN_2O)
GWP_N2O Global warming potential of N_2O = 310
BE_N2O,y,II Baseline emissions of N_2O in year y Hu-Chems II (tN_2O)
BE_N2O,y,III Baseline emissions of N_2O in year y Hu-Chems III (tN_2O)
BE_N2O,y,IV Baseline emissions of N_2O in year y Hu-Chems IV (tN_2O)

In order to ease the joint calculation of baseline emissions over all three nitric acid plants, conservative rounding has been done, i.e.plant specific baseline emissions (BE_y,II / BE_y,III / BE_y,IV) have been rounded down to whole numbers.

Calculation of plant specific baseline emissions of N_2O in the project activity

The calculation of plant specific baseline emissions of N_2O (BE_N2O,y,II for Hu-Chems II / BE_N2O,y,III for Hu-Chems III / BE_N2O,y,IV for Hu-Chems IV) is based on the same set of formulae. In the below section, this formulae are described in general, hence plant-specific suffixes in parameter names are neglected in this general description. Calculations of plant specific baseline emissions with actual values for the monitoring period are implemented in the excel books which are attached as *Annex 2* to this Monitoring Report.

In general, baseline emissions of N_2O (BE_N2O,y) are equal to the quantity of N_2O at inlet of destruction facility (QI_N2O,y), given that no regulations on N_2O emissions are in place and the production of HNO_3 is below the design capacity of a nitric acid plant.

$$BE\_N2O,y = QI\_N2O,y \quad \textbf{(31)}$$

Furthermore, operating conditions of the nitric acid plant (temperature and pressure of the ammonia oxidation reactor) and the actual ammonia flow rate to the ammonia oxidation reactor need to be considered. If monitored values of these parameters exceed permitted historical ranges/levels, baseline emissions of N_2O are to be conservatively determined according to provisions in the applied methodology (AM0028v1) and the revised monitoring plan. Additionally, if a different composition of ammonia oxidation catalyst gauzes compared to the historical composition is used, provisions related to the limitation of baseline emissions in the applied methodology (AM0028v1) and the revised monitoring plan are to be considered.

Parameter	Unit	Hu-Chems II	Hu-Chems III	Hu-Chems IV
BE_N2O,y	**tN2O**	**89.355**	**78.526**	**187.957**
QI_N2O,y	tN2O	89.355	78.526	187.957

where:

BE_N2O,y Baseline emissions of N_2O in year y (tN_2O)

QI_N2O,y Quantity of N_2O at inlet of the destruction facility in year y (tN_2O)

The quantity of N_2O at the inlet of the destruction facility (QI_N2O,y) is calculated based on continuous measurement of the tail gas volume flow rate (F_TG,i) and the N_2O concentration at the inlet of the N_2O destruction facility (CI_N2O,i).

$$QI\_N2O,y = \sum_i^n F\_TG,i \times CI\_N2O,i \times M\_i \quad \textbf{(32)}$$

Parameter	Unit	Hu-Chems II	Hu-Chems III	Hu-Chems IV
QI_N2O,y	**tN2O**	**89.355**	**78.526**	**187.957**

For calculation of parameter according to the formula (on a daily basis) please refer to excel books in Annex 2 of this monitoring report. Furthermore, please refer to the *special clarification regarding parameters QI_N2O,y and PE_N2O,y* under *Section C – 1 (Information Flow)* of this monitoring report.

where:

QI_N2O,y Quantity of N_2O at inlet of the destruction facility in year y (tN_2O)

F_TG,i Volume flow rate at the destruction facility inlet during interval i (Nm^3 / h)

CI_N2O,i N_2O concentration at destruction facility inlet during interval i (tN_2O / Nm^3)

M_i	Length of measuring interval i (h)
i	Interval
n	Number of intervals during the year

The specific N_2O emissions per unit of output nitric acid is defined as:

$$SE\_N2O,y = QI\_N2O,y / P\_HNO3,y \quad (33)$$

Parameter	Unit	Hu-Chems II	Hu-Chems III	Hu-Chems IV
SE_N2O,y	**tN2O / tHNO3**	**0.0126**	**0.0110**	**0.0066**
QI_N2O,y	tN2O	89.355	78.526	187.957
P_HNO3,y	tHNO3	7,073	7,169	28,382

where:

SE_N2O,y	Specific N2O emissions per output nitric acid in year y ($tN_2O/tHNO_3$)
QI_N2O,y	Quantity of N_2O emissions at inlet of the destruction facility in year y (tN_2O)
P_HNO3,y	Production of nitric acid in year (t HNO_3)

Other monitoring activities with effect on baseline emissions

Hu-Chems monitors the legal framework related to emission limits and related to national Korean GHG reduction regimes. During the monitoring period, no regulations which would limit the emission of N_2O applied to the Hu-Chems nitric acid plants, hence no limitation of the baseline emissions is to be adopted.

The production of nitric acid for the monitoring period is below the design capacity in all three nitric acid plants (Hu-Chems II / Hu-Chems III / Hu-Chems IV), hence no limitation of the baseline emissions is to be applied.

During the monitoring period, the daily average operating temperature did not exceed the permitted range for all days covered by the monitoring period in all three nitric acid plants (Hu-Chems II, Hu-Chems III and Hu-Chems IV), hence no limitation of the baseline emissions is to be applied.

During the monitoring period, the daily average operating pressure did not exceed the permitted range for all days covered by the monitoring period in all three nitric acid plants (Hu-Chems II, Hu-Chems III and Hu-Chems IV), hence no limitation of the baseline emissions is to be applied.

During the monitoring period, the composition of ammonia oxidation catalysts was the same as the historic composition of ammonia oxidation catalysts in all three nitric acid plants (Hu-Chems II, Hu-Chems III and Hu-Chems IV), hence no limitation of the baseline emissions is to be applied.

During the monitoring period, the daily ammonia flow rate to the ammonia oxidation reactor did not exceed the historical maximum for all days covered by the monitoring period in all three nitric acid plants (Hu-Chems II, Hu-Chems III and Hu-Chems IV) hence no limitation of the baseline emissions is to be applied.

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

>>

Project emissions of the project activity are determined based on the quantity of N_2O not destroyed by the destruction facility and emissions related to the operation of the destruction facility (i.e. emissions from ammonia and hydrocarbon input), taking production levels under consideration. Following monitoring activities have been done separately for each of the three nitric acid plants (Hu-Chems II, Hu-Chems III and Hu-Chems IV):

- The quantity of N_2O not destroyed (PE_N2O,y) is directly calculated by multiplying the measured tail gas volume flow rate and the measured N_2O concentrations;
- The quantity of hydrocarbon (Propane) to the EnviNOx® reactors of plants Hu-Chems II and Hu-Chems III has been monitored. No hydrocarbon is used in plant Hu-Chems IV;
- It has been monitored, if the production level of HNO_3 for the monitoring period was below the design capacity of the plant.

Excel books containing recorded monitored data, a comprehensive calculation of project emissions with actual values (formulae of calculation are shown in the spreadsheet cells for ease of assessment) and automatic checks of nitric acid production levels against design capacity are attached as *Annex 2*.

Calculation of total project emissions of the project activity
The total project emissions of the project activity during the monitoring period (PE_y) are the sum over the plant-specific project emissions (PE_y,II / PE_y,III / PE_y,IV):

PE_y = PE_y,II + PE_y,III + PE_y,IV = PE_ND,y + PE_DF,y **(34)**

Parameter	Unit	Hu-Chems Total
PE_y	**tCO2e**	**2,624**
PE_y,II	tCO2e	801
PE_y,III	tCO2e	524
PE_y,IV	tCO2e	1,299

PE_ND,y = PE_ND,y,II + PE_ND,y,III + PE_ND,y,IV **(35)**

Parameter	Unit	Hu-Chems Total
PE_ND,y	**tCO2e**	**2,495**
PE_ND,y,II	tCO2e	740
PE_ND,y,III	tCO2e	456
PE_ND,y,IV	tCO2e	1,299

PE_DF,y = PE_DF,y,II + PE_DF,y,III + PE_DF,y,IV **(36)**

Parameter	Unit	Hu-Chems Total
PE_DF,y	**tCO2e**	**129**
PE_DF,y,II	tCO2e	61
PE_DF,y,III	tCO2e	68
PE_DF,y,IV	tCO2e	0

Based on formulae (34), (35) and (36) above:
PE_,y,II = PE_ND,y,II + PE_DF,y,II **(37)**

Parameter	Unit	Hu-Chems II
PE_y,II	**tCO2e**	**801**
PE_ND,y,II	tCO2e	740
PE_DF,y,II	tCO2e	61

PE_,y,III = PE_ND,y,III + PE_DF,y,III **(38)**

Parameter	Unit	Hu-Chems III
PE_y,III	**tCO2e**	**524**
PE_ND,y,III	tCO2e	456
PE_DF,y,III	tCO2e	68

PE_,y,IV = PE_ND,y,IV + PE_DF,y,IV **(39)**

Parameter	Unit	Hu-Chems IV
PE_y,IV	**tCO2e**	**1,299**
PE_ND,y,IV	tCO2e	1,299
PE_DF,y,IV	tCO2e	0

where:

PE_y Project emissions in year y (tCO_2e)
PE_y,II Project emissions Hu-Chems II in year y (tCO_2e)
PE_y,III Project emissions Hu-Chems III in year y (tCO_2e)
PE_y,IV Project emissions Hu-Chems IV in year y (tCO_2e)
PE_ND,y Project emissions from N_2O not destroyed in year y (tCO_2e)
PE_DF,y Project emissions related to the operation of the destruction facility in year y (tCO_2e)

PE_ND,y,II Project emissions from N_2O not destroyed in year y Hu-Chems II (tCO_2e)
PE_ND,y,III Project emissions from N_2O not destroyed in year y Hu-Chems III (tCO_2e)
PE_ND,y,IV Project emissions from N_2O not destroyed in year y Hu-Chems IV (tCO_2e)
PE_DF,y,II Project emissions related to the operation of the destruction facility in year y Hu-Chems II (tCO_2e)
PE_DF,y,III Project emissions related to the operation of the destruction facility in year y Hu-Chems III (tCO_2e)
PE_DF,y,IV Project emissions related to the operation of the destruction facility in year y Hu-Chems IV (tCO_2e)

Calculation of plant specific project emissions from N_2O not destroyed and plant specific project emissions from the operation of the destruction facility

The calculation of plant specific project emissions from N_2O not destroyed in year y (PE_ND,y,II for Hu-Chems II / PE_ND,y,III for Hu-Chems III / PE_ND,y,IV for Hu-Chems IV) and plant specific project emissions related to the operation of the destruction facility (PE_DF,y,II for Hu-Chems II / PE_DF,y,III for Hu-Chems III / No such project emissions occur in Hu-Chems IV) is based on the same set of formulae. In the below section, this formulae are described in general, hence plant-specific suffixes in parameter names are neglected in this general description. Calculations of plant specific project emissions with actual values for the monitoring period are implemented in the excel books which are attached as *Annex 2* to this Monitoring Report.

PE_ND,y = PE_N2O,y x GWP_N2O **(40)**

Parameter	Unit	Hu-Chems II	Hu-Chems III	Hu-Chems IV
PE_ND,y	**tCO2e**	**740**	**456**	**1,299**
PE_N2O,y	tN2O	2.386	1.471	4.189
GWP_N2O	tCO2e / tN2O	310	310	310

where:
PE_ND,y Project emissions from N_2O not destroyed in year y (tCO_2e)
PE_N2O,y Project emissions of N_2O in year y (tN_2O)
GWP_N2O Global warming potential of N_2O = 310

In order to ease the joint calculation of project emissions over all three nitric acid plants, conservative rounding has been done, i.e.plant specific project emissions from N_2O not destroyed (PE_ND,y,II / PE_ND,y,III / PE_ND,y,IV) have been rounded up to whole numbers.

The quantity of N_2O not destroyed by the project activity (PE_N2O,y) is calculated based on continuous measurement of the tail gas volume flow rate (F_TG,i) and the N_2O concentration at the outlet of the N_2O destruction facility (CO_N2O,i).

$$PE\_N2O,y = \sum_i^n F\_TG,i \times CO\_N2O,i \times M\_i \quad \textbf{(41)}$$

Parameter	Unit	Hu-Chems II	Hu-Chems III	Hu-Chems IV
PE_N2O,y	**tN2O**	**2.386**	**1.471**	**4.189**

For calculation of parameter according to the formula (on a daily basis) please refer to excel books in Annex 2 of this monitoring report. Furthermore, please refer to the *special clarification regarding parameters QI_N2O,y and PE_N2O,y* under *Section C – 1 (Information Flow)* of this monitoring report.

where:
PE_N2O,y Project emissions of N_2O in year y (tN_2O)
F_TG,i Volume flow rate tail gas at destruction facility during interval i (Nm^3 / h)
CO_N2O,i N_2O concentration in the tail gas of the N_2O destruction facility during interval i (tN_2O / Nm^3)
M_i Length of measuring interval i (h)
i Interval
n Number of intervals during the year

Project emissions related to the operation of the destruction facility are calculated based on ammonia input to the destruction facility and hydrocarbon input to the destruction facility.

$$PE\_DF,y = PE\_NH3,y + PE\_HC,y \quad \textbf{(42)}$$

Parameter	Unit	Hu-Chems II	Hu-Chems III	Hu-Chems IV
PE_DF,y	**tCO2e**	**61**	**68**	**0**
PE_NH3,y	tCO2e	0	0	0
PE_HC,y	tCO2e	61	68	0

where:
PE_DF,y Project emissions related to the operation of the destruction facility in year y (tCO_2e)
PE_NH3,y Project emissions related to ammonia input to destruction facility in year y (tCO_2e)
PE_HC,y Project emissions related to hydrocarbon input to destruction facility in year y (tCO_2e)

Specifically to this project activity and as described in the PDD, following circumstances need to be considered with respect to project emissions related to the operation of the destruction facility:

- As SCR DeNOx units have been installed prior to the project activity, project emissions related to ammonia input to destruction to the facilities (PE_NH3,y) are zero for all three plants (Hu-Chems II, Hu-Chems III and Hu-Chems IV);

- No hydrocarbon is used in plant Hu-Chems IV, consequently no project emissions related to hydrocarbon use occur in plant Hu-Chems IV, hence project emissions from hydrocarbon use in destruction facility are zero in plant Hu-Chems IV (PE_HC,y,IV).
- The EnviNOx® systems in plant Hu-Chems II and plant Hu-Chems III are designed to use propane as reducing agent. No methane is used nor is it present in the hydrocarbon. Hence, emissions from non-converted methane do not occur and the parameter (HCE_NC,y) are zero;

PE_HC,y = HCE_C,y + HCE_NC,y **(43)**

Parameter	Unit	Hu-Chems II	Hu-Chems III	Hu-Chems IV
PE_HC,y	**tCO2e**	**61**	**68**	**0**
HCE_C,y	tCO2e	61	68	Not applicable
HCE_NC,y	tCO2e	0	0	Not applicable

where:
PE_HC,y Project emissions related to hydrocarbon input to destruction facility in year y (tCO_2e)
HCE_C,y Converted hydrocarbon emissions in year y (tCO_2e)
HCE_NC,y Methane emissions in year y (tCO_2e)

Specifically to this project activity and as described in the PDD, following circumstances need to be considered with respect of project emissions related to hydrocarbon input:

- For converted hydrocarbon emissions, conservative option according to the methodology (complete conversion of propane to CO_2) is applied per default. Applied assumption of full conversion (OXID_HC = 100%) of hydrocarbon (Propane) to CO_2 leads to maximum project emissions theoretically possible from this source in the emission reduction calculation.

HCE_C,y = ρ_HC x Q_HC,y x EF_HC x OXID_HC/100 **(44)**

Parameter	Unit	Hu-Chems II	Hu-Chems III
HCE_C,y	**tCO2e**	**61**	**68**
ρ_HC	t / Nm³	$2.00*10^{-3}$	$2.00*10^{-3}$
Q_HC,y	Nm³	10,020	11,325
EF_HC	tCO2e / t HC	3.0	3.0
OXID_HC	%	100	100

where
HCE_C,y Converted hydrocarbon emissions in year y (tCO_2e)
ρ_HC Hydrocarbon density (t / Nm³)
Q_HC,y Hydrocarbon input in year (Nm³)
EF_HC Carbon emission factor of hydrocarbon (tCO_2 / t HC)
OXID_HC Oxidation factor of hydrocarbon (%)

In order to ease the joint calculation of project emissions over all three nitric acid plants, conservative rounding has been done, i.e.plant specific converted hydrocarbon emissions (HCE_C,y,II and HCE_C,y,III) have been rounded up to whole numbers.

Other monitoring activities with effect on project emissions
The production of nitric acid for the monitoring period is below the design capacity in all three nitric acid plants (Hu-Chems II / Hu-Chems III / Hu-Chems IV), hence no limitation of the project emissions is to be applied.

E.3. Calculation of leakage

>>

According to AM0028v1, leakage emissions need only to be analyzed if the project activity does not involve any energy recovery from the tail gas. A tail gas turbine is installed end of pipe in all three plants (Hu-Chems II, Hu-Chems III and Hu-Chems IV), hence LE_y is zero for all plants.

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	110,308	2,624	0	107,684

The total emission reduction achieved by this project activity during the monitoring period is the difference between baseline emissions (BE_y), project emissions (PE_y) and leakage emissions (LE_y).

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)	**One year: 1,280,429** **Monitoring period (24 days): 84,193**	**107,684**

Reason for the increase in actual emission reductions achieved during the current monitoring period compared to ex-ante calculation of the registered PDD is given in section E.6. below. It should be noted that the ex-ante estimation of emissions reductions in the PDD was generally based on conservative assumptions.

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

>>

Comparison of emission reductions with PDD values – Hu-Chems II

Comparison of ER with PDD values: Hu-Chems II	
Source	**Value**
Emission reduction estimation according to PDD (one year; rounded)	329,397 tCO2e
Corresponding PDD estimation (over 24 days; rounded)	21,659 tCO2e
Actual calculation of emission reduction in monitoring period (over 24 days)	26,899 tCO2e

The increase of the actual emission reduction during the monitoring period compared to the corresponding ex-ante estimation according to the PDD is caused by following reasons:

- For the PDD calculation, a destruction rate of [94.00%] was used, the actual destruction rate reaches an average level of about [97.33%];
- Due to the absence of actual values, an inlet concentration of [$3.5*10^{-6}$ tN_2O / Nm^3] for baseline emission estimation in the PDD was used. Actual concentrations measured reach an average level of [$4.1*10^{-6}$ tN_2O / Nm^3] and therefore lead to higher baseline emissions;

Comparison of emission reductions with PDD values – Hu-Chems III

Comparison of ER with PDD values: Hu-Chems III	
Source	**Value**
Emission reduction estimation according to PDD (one year; rounded)	329,397 tCO2e
Corresponding PDD estimation (over 24 days; rounded)	21,659 tCO2e
Actual calculation of emission reduction in monitoring period (over 24 days)	23,818 tCO2e

The increase of the actual emission reduction during the monitoring period compared to the corresponding ex-ante estimation according to the PDD is caused by following reasons:

- For the PDD calculation, a destruction rate of [94.00%] was used, the actual destruction rate reaches an average level of about [98.13%];

Comparison of emission reductions with PDD values – Hu-Chems IV

Comparison of ER with PDD values: Hu-Chems IV	
Source	**Value**
Emission reduction estimation according to PDD (one year; rounded)	621,634 tCO2e
Corresponding PDD estimation (over 24 days; rounded)	40,875 tCO2e
Actual calculation of emission reduction in monitoring period (over 24 days)	56,967 tCO2e

The increase of the actual emission reduction during the monitoring period compared to the corresponding ex-ante estimation according to the PDD is caused by following reasons:

- For the PDD calculation, a destruction rate of [94.00%] was used, the actual destruction rate reaches an average level of about [97.77%];
- Due to the absence of actual values, an inlet concentration of [$1.7*10^{-6}$ tN_2O / Nm^3] for baseline emission estimation in the PDD was used. Actual concentrations measured reach an average level of [$2.1*10^{-6}$ tN_2O / Nm^3] and therefore lead to higher baseline emissions;
- Due to the absence of tail gas flow measurement, the tail gas flow used for emission reduction determination in the PDD was estimated with [149,675 Nm^3 / h]. Actual flows measured reach an average level of [158,292 Nm^3 / h] and therefore contribute to a higher emission reduction than estimated.

ANNEX 1 - Social Fund

As described in the PDD a Social Fund was established by the project developer and the project operator. This fund contributes to the social benefit of the people living in the area of the project activity by financing projects and social activities. Projects and organizations that have been supported by the CDM Social Fund are the Yeo-do academy (improvement of basic elementary and secondary education), the In-Company welfare fund (contribution to working employee's life stabilization and welfare improvement) as well as the Sang-Am village fund. Furthermore, donations towards disabled people and people endangered from poverty as well as towards projects for environmental conservation have been made. Evidence / Documentation on contributions and donations is made available to the DOE for verification. Payments from the CDM Project to the Social Fund in the recent years were at follows:

- Social Fund 2007: 250,931,278 WON (~ 150,000 Euro)
- Social Fund 2008: 854,902,652 WON (~ 530,000 Euro)
- Social Fund 2009: 582,706,027 WON (~ 320,000 Euro)
- Social Fund 2010: 618,891,360 WON (~ 400,000 Euro)
- Social Fund 2011: 911,028,406 WON (~ 590,000 Euro)

ANNEX 2 - Excel books for claiming Emission Reductions

Excel books containing monitored data and calculations of baseline emissions, project emissions and emission reductions as additional checks and information are attached as separate files:

HUC_II_MP23_UNFCCC_CONFIDENTIAL.xlsx
HUC_III_MP23_ UNFCCC_CONFIDENTIAL.xlsx
HUC_IV_MP23_ UNFCCC_CONFIDENTIAL.xlsx
HUC_OVERALL_MP23_ UNFCCC_CONFIDENTIAL.xlsx

- - - - -

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.
Decision Class: Regulatory **Document Type**: Form **Business Function**: Issuance		