**MONITORING REPORT FORM (CDM-MR)**
**Version 01 - in effect as of: DD/MM/YYYY**

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**MONITORING REPORT**
**Version 1 – 08/07/2010**

**Catalytic $N_2O$ destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp.**
**UNFCCC 0765**
**Monitoring Period 13: 01/04/2010 – 30/06/2010**

## SECTION A. General description of the project activity

### A.1. Brief description of the project activity: >>

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1. 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.

2. 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.

3. 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.

4. Total emission reductions achieved in this monitoring period: **371,906 $tCO_2e$**

## A.2. Project Participants

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| Name of Party involved | Project participants (as applicable) | Party involved considered as project participant |
|---|---|---|
| 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.3. Location of the project activity:

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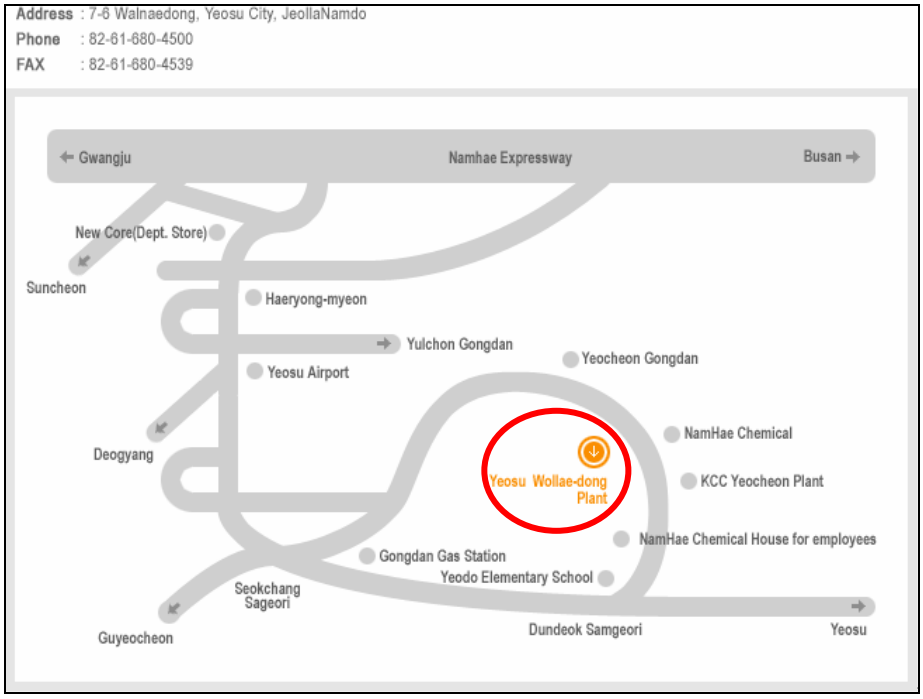
Country: Republic of Korea
Province: Jeollanam-do
Town: Yeosu
GPS coordinates: N34.848686° E127.743198°




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.4. Technical description of the project

>>

**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)[1]:

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

[1] 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.

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 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 Hu-Chems II + 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:

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

Effectively 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:

$7\ N_2O + C_3H_8 \rightarrow 7\ N_2 + 4\ H_2O + 3\ CO$ **(16)**
$10\ N_2O + C_3H_8 \rightarrow 10\ N_2 + 4\ H_2O + 3\ CO_2$ **(17)**
$5\ O_2 + C_3H_8 \rightarrow 4\ H_2O + 3\ CO_2$ **(18)**
$7\ O_2 + 2\ C_3H_8 \rightarrow 8\ H_2O + 6\ CO$ **(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:

$2\ CO + O_2 \rightarrow 2\ CO_2$ **(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:

$2\ N_2O \rightarrow 2\ N_2 + O_2$ **(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:

$6\ NO_2 + 8\ NH_3 \rightarrow 7\ N_2 + 12\ H_2O$ **(22)**
$6\ NO + 4\ NH_3 \rightarrow 5\ N_2 + 6\ H_2O$ **(23)**
$NO + NO_2 + 2\ NH_3 \rightarrow 2\ N_2 + 3\ H_2O$ **(24)**
$4\ NO + O_2 + 4\ NH_3 \rightarrow 4\ N_2 + 6\ H_2O$ **(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.

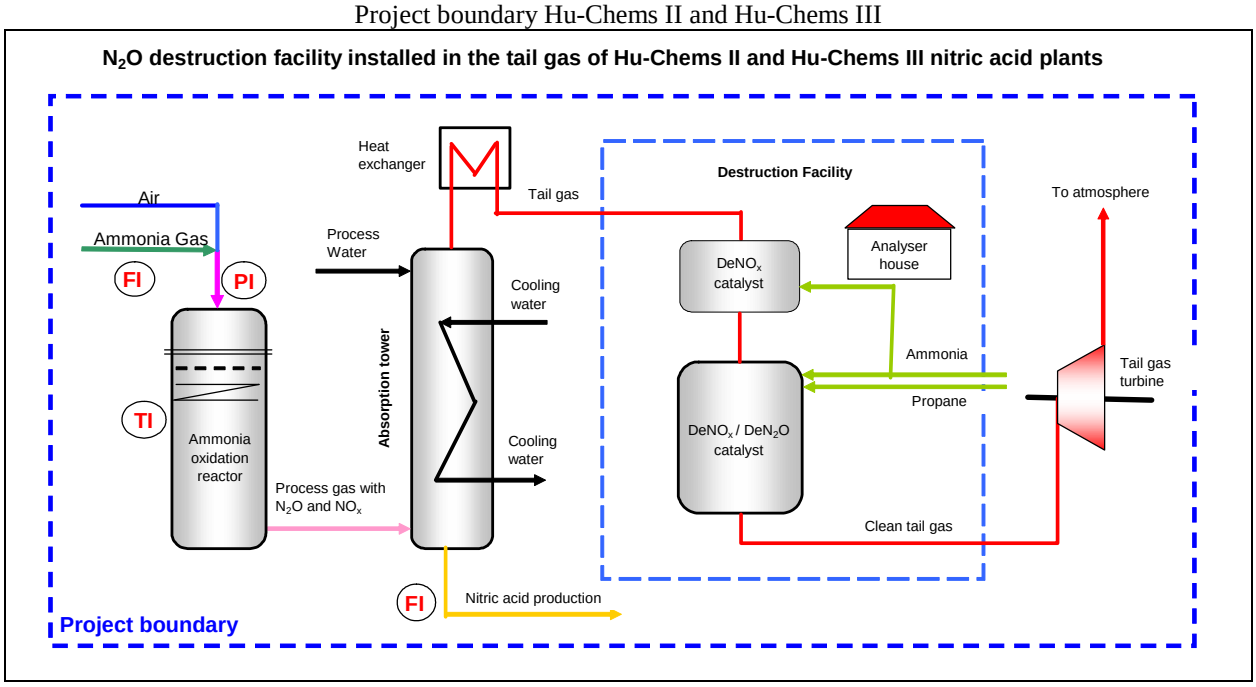
Technology employed by the project activity:

In this project, CARBON CDM Korea installed three EnviNOx® systems for catalytic reduction and decomposition of NOx and $N_2O$ 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 implementation of the $N_2O$ destruction project at Hu-Chems II and Hu-Chems III involves that propane is employed as a reducing agent for $N_2O$ removal.

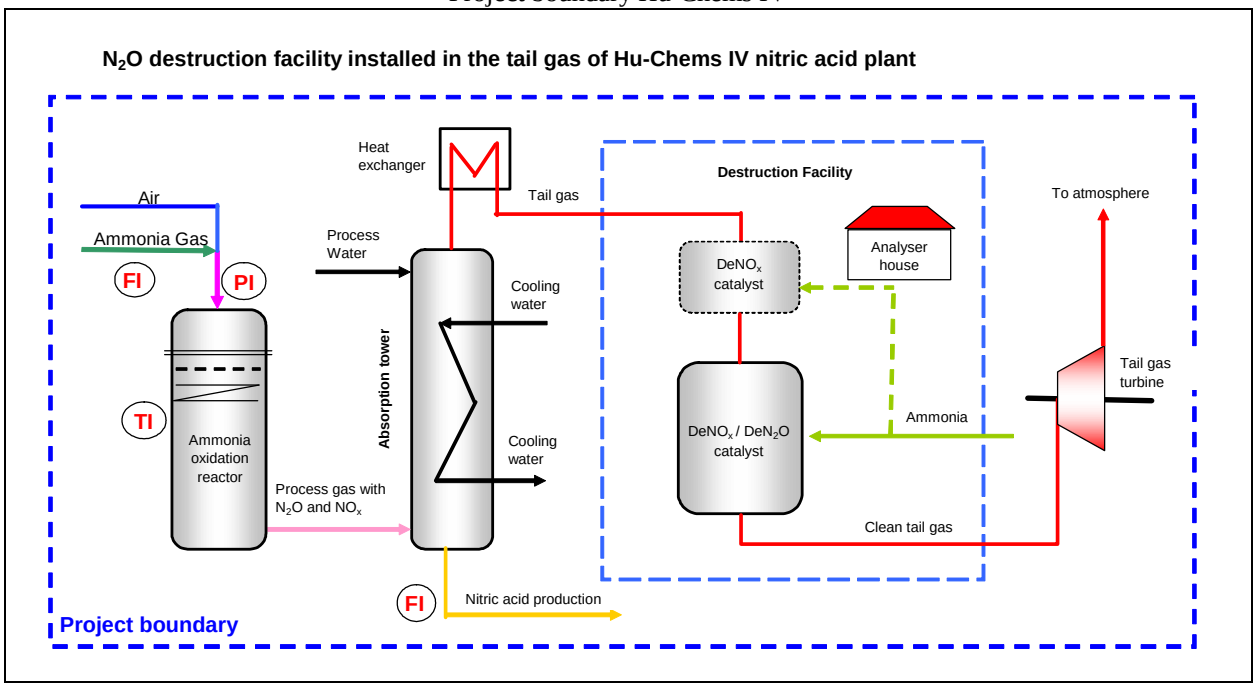
Location of the EnviNOx®-Systems:
Hu-Chems II: The new EnviNOx® reactor (322-R-202) is located between the existing SCR DeNOx reactor (322-R-201) and the tail gas turbine (322-C-201-T2) which is the position with the highest tail gas temperature in the nitric acid production process at Hu-Chems II.
Hu-Chems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



**A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:**

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**Applied Baseline methodology**:
AM0028, Version 1: "Catalytic $N_2O$ destruction in the tail gas of Nitric Acid Plants"; submitted by Carbon Projektentwicklung GmbH

**Applied Monitoring methodology**:
AM0028, Version 1: "Catalytic $N_2O$ destruction in the tail gas of Nitric Acid Plants"; submitted by Carbon Projektentwicklung GmbH

**A.6. Registration date of the project activity:**

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22/01/2007 (CDM Reference Number: 0765)

Title of the project activity according to the PDD: "Catalytic $N_2O$ destruction project in the tail gas of three Nitric Acid Plants at Hu-Chems Fine Chemical Corp."

Date of Completion of PDD: 22/07/2006 (PDD Version 2)

**A.7. Crediting period of the project activity and related information (start date and choice of crediting period):**

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| | |
|---|---|
| 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) |

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 |

**A.8. Name of responsible person(s)/entity(ies):**

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**Responsible for completing the CDM-MR:**

| **On behalf of CARBON CDM Korea Ltd.** | | |
|---|---|---|
| Name | Andreas Rammelmüller | Franz Zaiser |
| Position | Project Manager | Project Assistant |
| Email | rammelmueller@carbon-austria.com | zaiser@carbon-austria.com |
| Phone Number | +43 2734 322 70-60 | +43 2734 322 70-11 |

**Supervision:**

| **CARBON Austria** | |
|---|---|
| Name | Gerald Dunkel |
| Position | JI/CDM Director |
| Email | Dunkel@carbon-austria.com |
| Phone Number | +43 2734 322 70-30 |

## SECTION B. Implementation of the project activity

### B.1. Implementation status of the project activity

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#### 1. Project implementation status and operational status

The operation of the projected activity started in the beginning of January 2007 at Hu-Chems IV and in the end of March 2007 at Hu-Chems II and Hu-Chems III. The project has been 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 registered monitoring plan (as per the revision approved by the CDM EB on 18/03/2010).

#### 2. Actual operation of the Project Activity during the covered monitoring period

Downtimes & Campaigns of the Nitric Acid Plants

During the below mentioned periods, the Nitric Acid Plants were out of operation due to the given reasons.

Downtimes of the nitric acid plants

| Nitric Acid Plant downtimes | | | | | |
|---|---|---|---|---|---|
| **Plant** | **Downtime - Start** | | **Downtime - End** | | **Downtime Reason** |
| **Plant II** | **Date** | **Time** | **Date** | **Time** | **Description** |
| II | 08.04.2010 | 04:00 | 09.04.2010 | 00:00 | Exchange of Ammonia Oxidation Catalyst |
| II | 14.06.2010 | 02:00 | 22.06.2010 | 16:00 | Plant maintenance works / Overhaul of air compressor |
| **Plant III** | **Date** | **Time** | **Date** | **Time** | **Description** |
| III | 17.05.2010 | 02:00 | 18.05.2010 | 03:00 | Exchange of Ammonia Oxidation Catalyst |
| **Plant IV** | **Date** | **Time** | **Date** | **Time** | **Description** |
| IV | 04.05.2010 | 14:00 | 07.05.2010 | 21:00 | Exchange of Ammonia Oxidation Catalyst |

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:** 07/01/2010 **Campaign end:** 08/04/2010 | **Campaign start:** 10/02/2010 **Campaign end:** 17/05/2010 | **Campaign start:** 21/10/2009 **Campaign end:** 04/05/2010 |
| Duration of campaign 2 (applicable, if new campaign started during monitoring period) | **Campaign start:** 08/04/2010 **Campaign end:** Ongoing at the end of the Monitoring Period | **Campaign start:** 17/05/2010 **Campaign end:** Ongoing at the end of the Monitoring Period | **Campaign start:** 04/05/2010 **Campaign end:** Ongoing at the end of the Monitoring Period |

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

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 | | | | | |
|---|---|---|---|---|---|
| **Plant** | **Downtime - Start** | | **Downtime - End** | | **Downtime Reason** |
| **Plant II** | **Date** | **Time** | **Date** | **Time** | **Description** |
| II | 07.04.2010 | 22:00 | 09.04.2010 | 02:00 | Shutdown of NA Plant (Exchange of Ammonia Oxidation Catalyst) |
| II | 13.06.2010 | 20:00 | 22.06.2010 | 17:00 | Shutdown of NA Plant (Plant maintenance works / Overhaul of air compressor) |
| **Plant III** | **Date** | **Time** | **Date** | **Time** | **Description** |
| III | 20.04.2010 | 02:00 | 20.04.2010 | 14:00 | Shutdown of EnviNOx system (Valve malfunction and repair works) |
| III | 16.05.2010 | 21:00 | 18.05.2010 | 05:00 | Shutdown of NA Plant (Exchange of Ammonia Oxidation Catalyst) |
| **Plant IV** | **Date** | **Time** | **Date** | **Time** | **Description** |
| IV | 04.05.2010 | 14:00 | 07.05.2010 | 22:00 | Shutdown of NA Plant (Exchange of Ammonia Oxidation Catalyst) |

Observations during the monitoring period relevant calculation of ER

During the below mentioned periods, observations related to the operation of the EnviNOx® system and the AMS have been made. All observations were caused by normal and scheduled services, no malfunction of monitoring equipments leading to missing/incomplete monitoring data were observed.

*EnviNOx® System at Nitric Acid Plant #2*

Between 29/04/2010 (11:00) and 30/04/2010 (09:00) the inlet analyser was out of operation due to maintenance reasons (Emerson engineers performed a regular quarterly inspection on these days). During this period, the nitric acid plant as well as the EnviNOx® system were in normal operation and Emissions Reductions have been conservatively determined as described in section C - 4 (Systematic Measures) of this Monitoring Report, fully in line with the applied methodology and the registered PDD.

On 12/05/2010 between 10:00 and 18:00, the governmental Korean Testing Laboratory performed the analyser certification and test procedure for the inlet and the outlet analyser, respectively. Due to intermittent operating conditions of the EnviNOx® system, conservatively no emission reductions are claimed during this period.

*EnviNOx® System at Nitric Acid Plant #3*

On 13/05/2010 between 09:00 and 18:00, the governmental Korean Testing Laboratory performed the analyser certification and test procedure for the analysers. On 16/06/2010 between 11:00 and 12:00, Emerson Process Management Korea has performed a sample line check for the analysers. During these periods, the nitric acid plant as well as the EnviNOx® system were in normal operation and Emissions Reductions have been conservatively determined as described in section C - 4 (Systematic Measures) of this Monitoring Report, fully in line with the applied methodology and the registered PDD.

*EnviNOx® System at Nitric Acid Plant #4*

On 11/05/2010 between 10:00 and 20:00, the governmental Korean Testing Laboratory performed the analyser certification and test procedure for the analysers. On 16/06/2010 between 12:00 and 14:00, Emerson Process Management Korea has performed a sample line check for the analysers. During these periods, the nitric acid plant as well as the EnviNOx® system were in normal operation and Emission Reductions have been conservatively determined as described in section C - 4 (Systematic Measures) of this Monitoring Report, fully in line with the applied methodology and the registered PDD.

Other observations during the monitoring period
Regular health check and inspection visit services (see "Calibration and Maintenance" below and section C – 3) have been conducted by Emerson Process Management Korea in April 2010, May 2010 and June 2010 and attest good condition and availability of the whole system. Sample line checking by applying test at the beginning of the sample line has been performed for all analysers of all three plants in June 2010 and showed positive results. General maintenance services (see "Calibration and Maintenance" below and section C – 3) have been conducted for plants II and IV in May and June, respectively and attest good condition of all instruments. Reports of all conducted services are made available to the DOE for verification.

Calibration and Maintenance
All measuring and analytical instruments are being calibrated as defined in the Approved Methodology AM0028 and the monitoring plan in its present version (revision approved by the CDM EB on 18/03/2010). The maintenance methods and procedures 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). Records of conducted maintenance activities are available and submitted to the DOE for verification.

As 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, measurement devices and the automated monitoring system required for the monitoring of the CDM project are covered by these contracts. Service reports of conducted health checks, inspection visits and further maintenance activities and checks, respectively are available and submitted to the DOE for verification.

Instrument calibration and maintenance scheme is performed according to Hu-Chems quality management procedures. Maintenance procedures for monitoring instruments used for CDM Monitoring have been incorporated as part of the ISO 9001 procedures. 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 all monitoring instruments related to the CDM Project.

**3. Situations with impact on the applicability of the methodology**

No such situations occurred during the covered monitoring period.

## B.2. Revision of the monitoring plan

>>
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. Monitoring of the project is done according to the monitoring plan in its present version.

## B.3. Request for deviation applied to this monitoring period

>>
No deviation has applied to this monitoring period.

## B.4. Notification or request of approval of changes

>>
No notification or requeste of approval of changes from the project activity as described in the registered CDM PDD applies to this monitoring period.

## SECTION C. Description of the monitoring system

### 1. Information flow

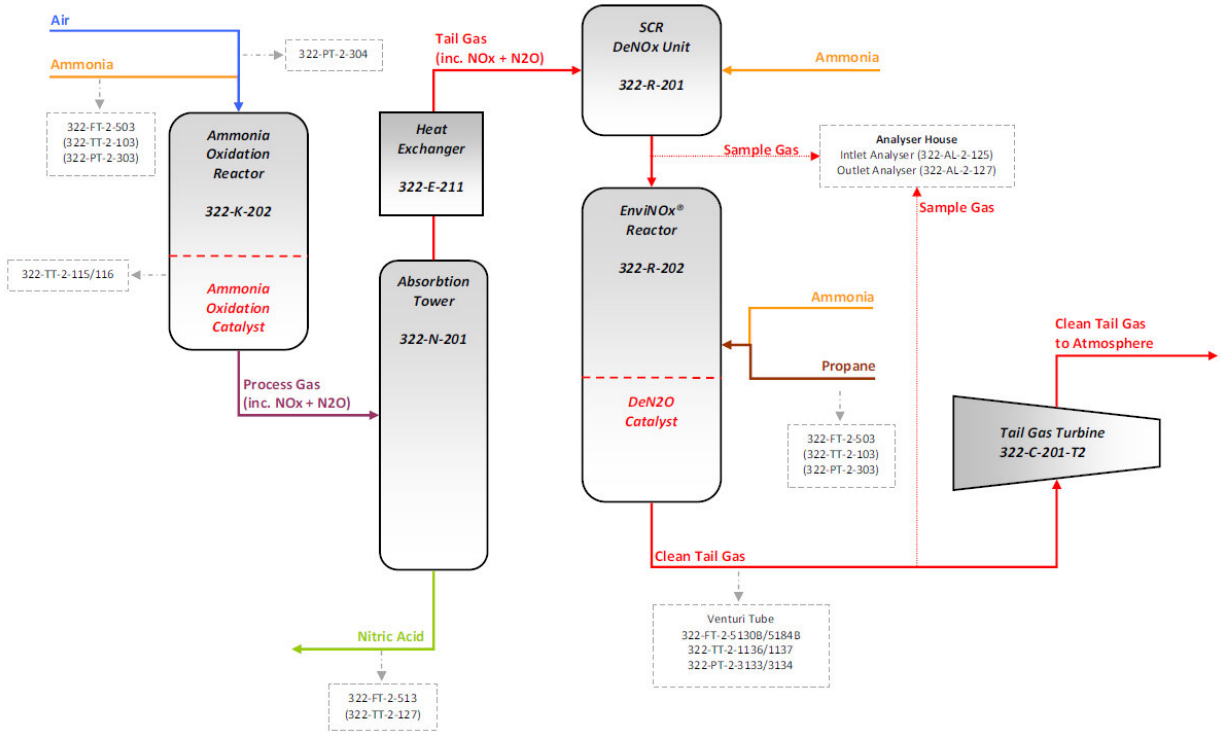
The instruments transmitters continuously provide a 4 - 20 mA analogue signal according to range and units configured. These signals are transmitted to I/O cards (analogue input/output cards) and collected by the DeltaV Processor. Resulting digital values are made available in the network to be further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

Following calculations, relevant for the calculation of emission reductions, are already conducted on a continuous basis and also stored as data in the CHS:

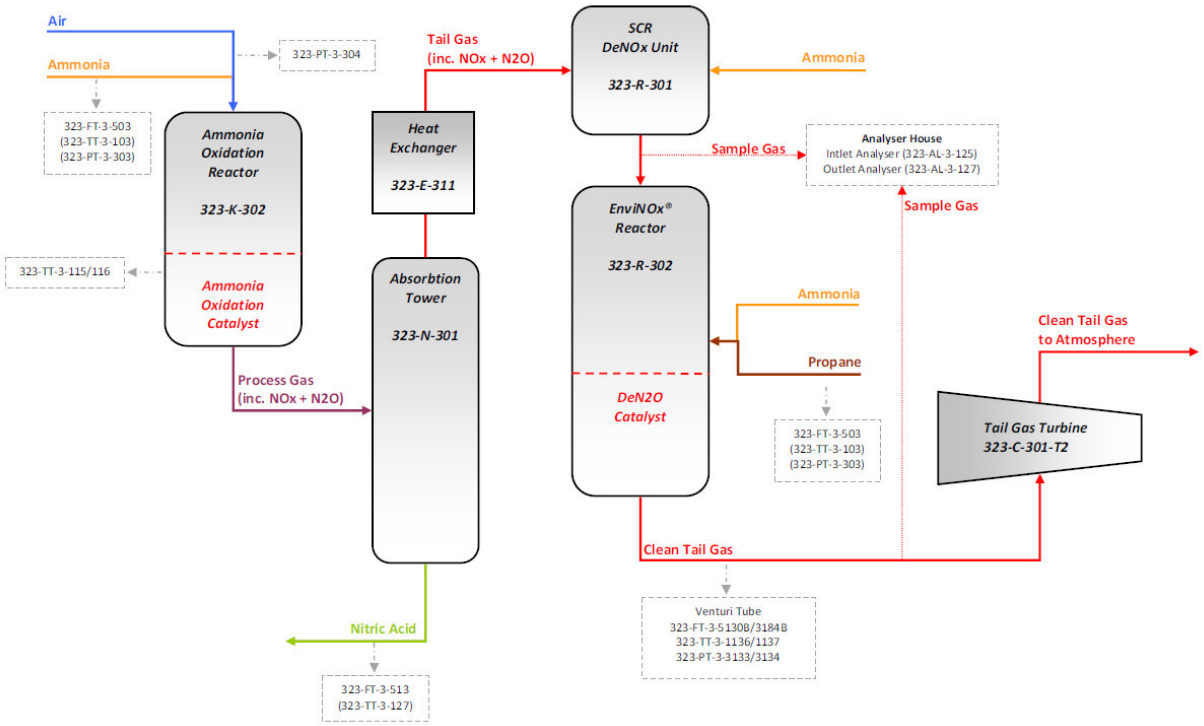
- Conversion of volume flows (Tail gas, Propane, Ammonia to AOR) into standard conditions (based on temperature and pressure measurement)
- N2O at the inlet and outlet of the destruction facility (QI_N2O and PE_N2O)

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

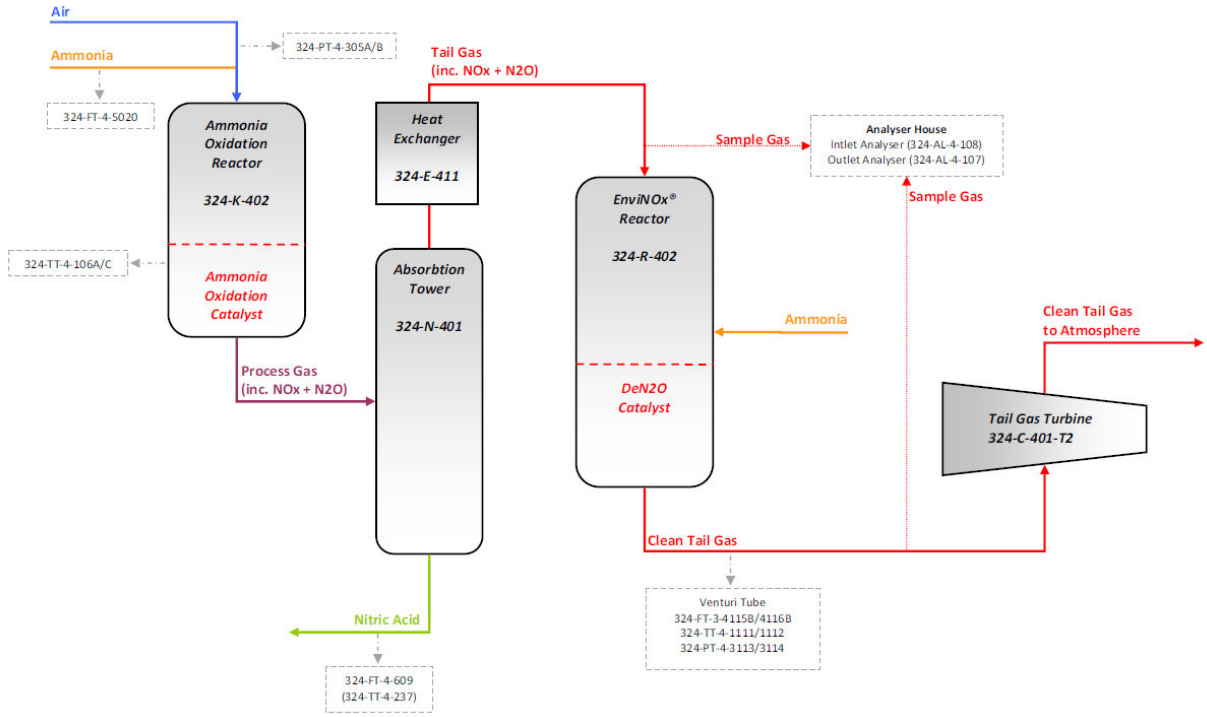
Line-Diagram including the location of the monitoring instruments / Hu-Chems II



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




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



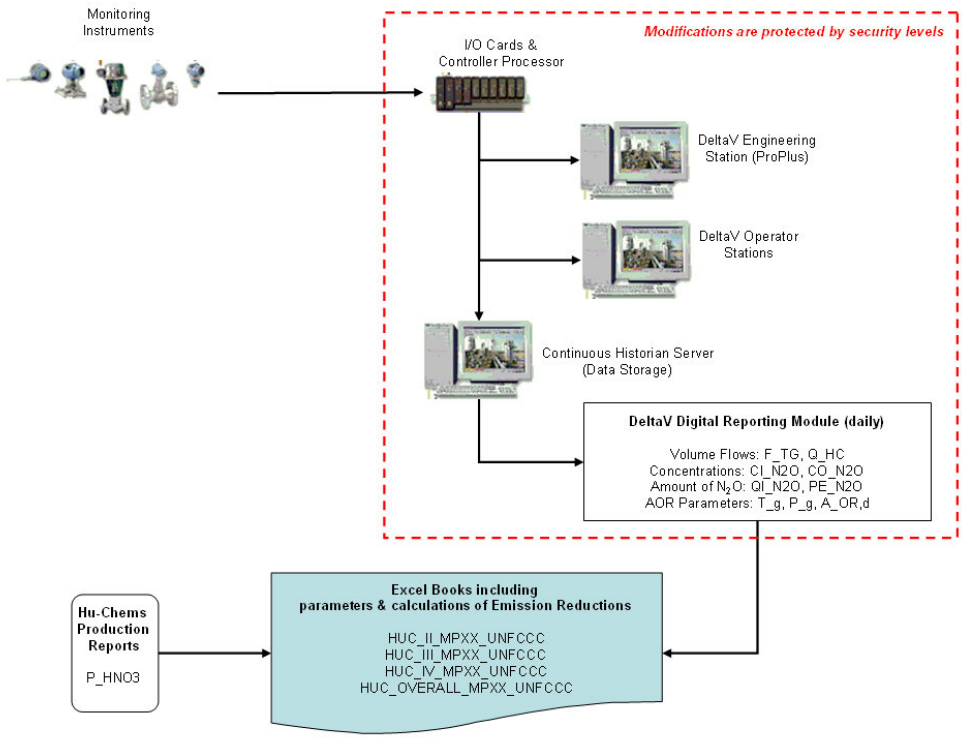
The reporting module of the DeltaV system automatically generates aggregated daily reports based on the stored raw data from the continuous historian server, including totals (flows) and averages (concentrations). Daily reports contain following kinds of data (separately for each plant):

- Concentrations of $N_2O$ at the inlet and outlet of the EnviNOx® systems (CI_N2O, CO_N2O)
- Volume Flows (F_TG; Q_HC)
- Amount of $N_2O$ at the inlet and outlet of the EnviNOx® systems (QI_N2O, PE_N2O)
- Operating parameters of the nitric acid plant (T_g, P_g, A_OR,d)

Relevant parameters as above (Concentrations, Volume Flows, Amounts of $N_2O$, Operating parameters of the nitric acid plant) are exported from the digitally available daily reports to excel sheets (separately for each plant) for presentation of required parameters and calculation of baseline emissions (BE, BE_N2O, SE_N2O), project emissions (PE, PE_ND, PE_DF, PE_HC, HCE_C), and emission reductions (ER) according to the formulae as required per the methodology and the PDD. Daily production of nitric acid plant is obtained from Hu-Chems daily production reports and transferred to these excel sheets (These excel sheets are provided as separate attachment to this monitoring report, please see Annex 2 after on-site verification).

The above methods apply to all three nitric acid plants and EnviNOx® systems.

Information flow diagram




This approach and all implemented formulas in the Delta V system fully comply 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). The above methods apply to all three nitric acid plants and EnviNOx® systems.

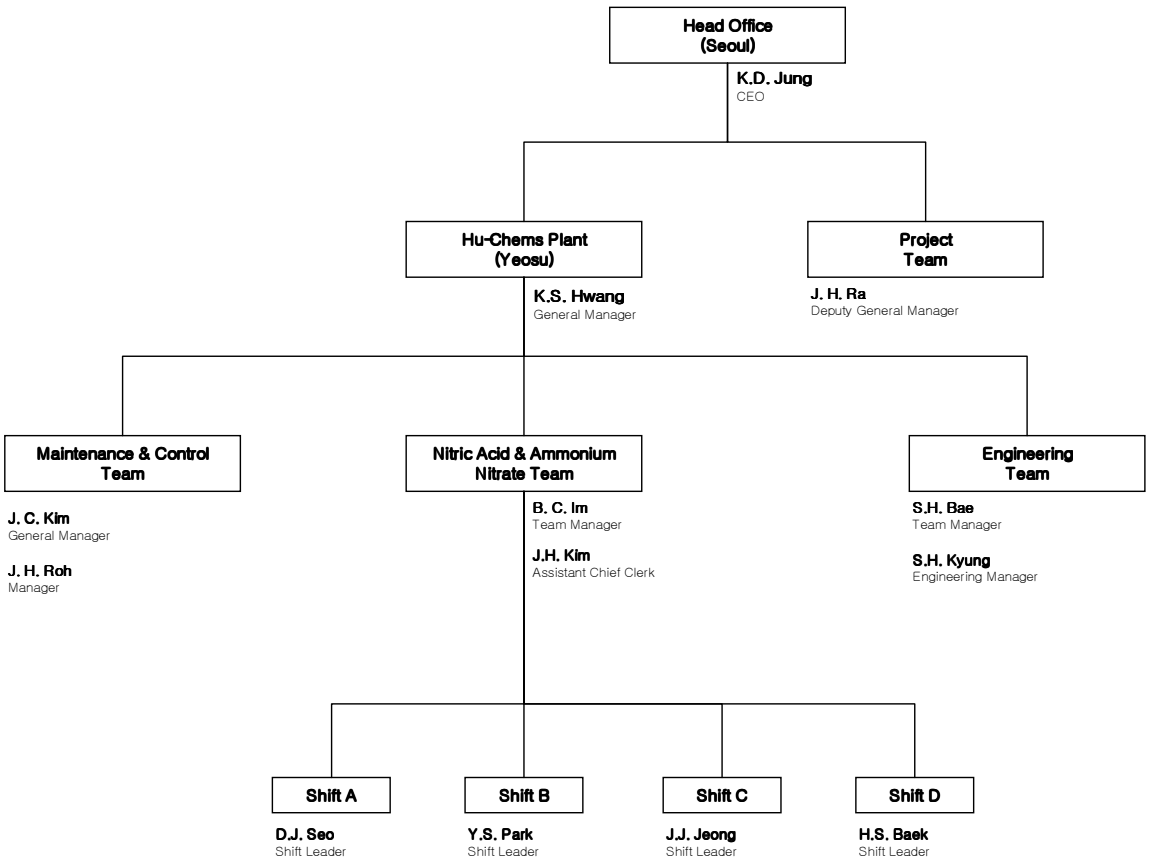
## 2. Roles and responsibilities of personnel

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.

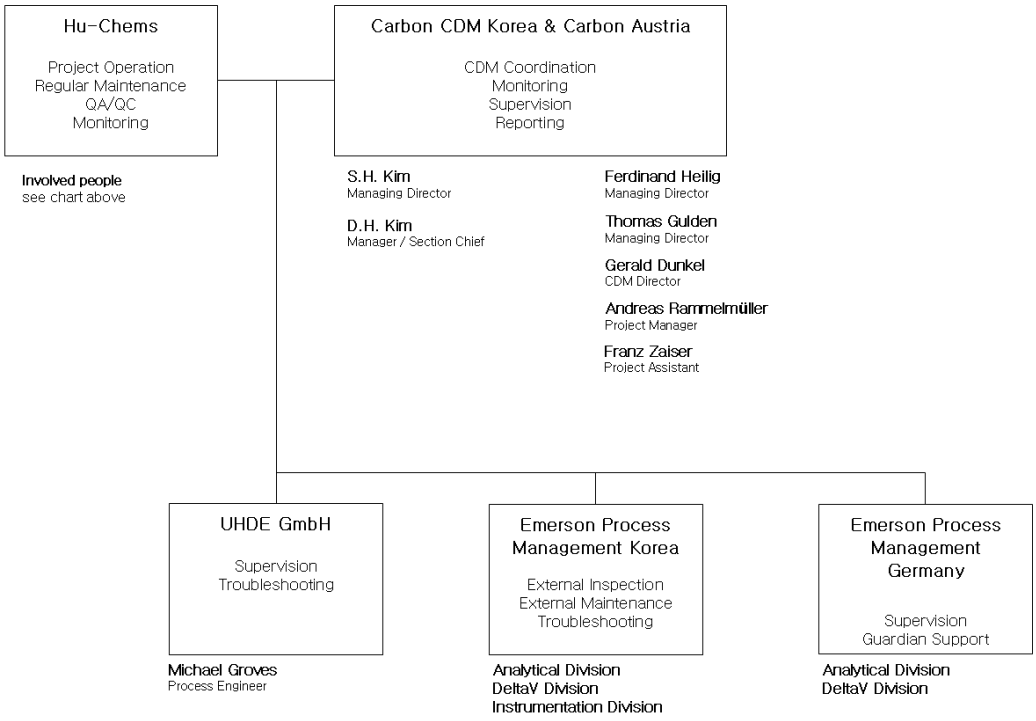
The operating and maintenance personal of the EnviNOx® system have been trained by the technology provider UHDE and the supplier of the digital process control system (Delta V, M/s. process management), further Hu-Chems has established internal training plans on the CDM procedures, operation of the EnviNOx® 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. Carbon Austria gives their final approval on the supporting documents as well as the CDM-MR before submitting to the respective DOE for quarterly 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 contracted Emerson Process Management Korea to execute **regular general calibration services** and **regular general maintenance services** for all related monitoring instruments on a regular basis, associated with the shut-down schedule of the nitric acid plants and adopted to plant requirements. The service inter alia consists of hardware and connection maintenance as well as software checks and error diagnostics. Service reports of performed services 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 |
| Emerson Process Management Korea (EPMK) | Health check of AMS System | Monthly | Health Check Report |
| EPMK | Health Check of Instruments | Monthly | Health Check Report |
| EPMK | Inspection check of AMS System | Quarterly | Inspection Check Report |
| EPMK | Inspection check of Instruments | Quarterly | Inspection Report |
| EPMK | General Maintenance of instruments | Adopted to shut-down schedule of plant | General Maintenance Report |
| UHDE | Supervision | Continuously | Plausibility Check |

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, demonstration of normal plant operation and estimation of emission reductions are conducted according to the PDD. The procedure how to determine the Emissions Reductions during AMS down times and to ensure suitability and conservativeness is a six-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 Envi$NO_X$® system is under normal operation
Suitable operating parameters are provided, in order to demonstrate that the Envi$NO_X$® system is operating under normal conditions.

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

(4) Conservativeness check
Conservativeness is ensured by considering limiting values when determining the missing parameter. Such are minimum (or maximum) thresholds (depending on baseline or project emission determination) obtained from hours prior and after the AMS downtime.

(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.

(6) Operation check
Operating parameters of the nitric acid plant and the EnviNOx® system are compared with values prior and after the AMS was out of operation or deactivated for maintenance reasons to ensure that those values are within a plausible range.

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

## SECTION D. Data and parameters

### D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

**Data and parameter not monitored for Hu-Chems II**

| **Data / Parameter:** | **EF_HC,II** |
|---|---|
| Data unit: | $tCO_2e/t$ |
| Description: | Hydrocarbon $CO_2$ emission factor Hu-Chems II |
| Source of data used: | According to the PDD |
| Value(s) : | **3.0 $tCO_2e$/tPropane** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **OXID_HC,II** |
|---|---|
| Data unit: | % |
| Description: | Hydrocarbon oxidation factor Hu-Chems II |
| Source of data used: | According to the PDD;<br>According to AM0028 OXID_HC,II is 100% (conservative approach) |
| Value(s) : | **100%** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **Type_HC,II** |
|---|---|
| Data unit: | - |
| Description: | Type of hydrocarbon |
| Source of data used: | Hydrocarbon supplier |
| Value(s) : | **Propane** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **P_HNO3,hist,II** |
|---|---|
| Data unit: | $tHNO_3$ |
| Description: | Design capacity |
| Source of data used: | According to PDD |
| Value(s) : | **116,800 $tHNO_3$** |

| | |
|---|---|
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **T_g,hist,II** |
|---|---|
| Data unit: | °C |
| Description: | Historical operating temperature of the ammonia oxidation reactor Hu-Chems II |
| Source of data used: | According to PDD |
| Value(s) : | **880 – 910 °C** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **P_g,hist,II** |
|---|---|
| Data unit: | barg |
| Description: | Historical operating pressure of the ammonia oxidation reactor Hu-Chems II |
| Source of data used: | According to PDD |
| Value(s) : | **5.0 – 9.8 barg** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **G_sup,hist,II** |
|---|---|
| Data unit: | - |
| Description: | Historical supplier of the ammonia oxidation catalyst Hu-Chems II |
| Source of data used: | According to PDD |
| Value(s) : | **Johnson Matthey** and/or **Umicore** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **G_com,hist,II** |
|---|---|
| Data unit: | % |
| Description: | Historical composition of the ammonia oxidation catalyst Hu-Chems II and Hu Chems III |
| Source of data used: | According to PDD |
| Value(s) : | **90% Pt**<br>**5% Rh** |

| | |
|---|---|
| | **5% Pd** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **A_OR,hist,II** |
|---|---|
| Data unit: | $tNH_3/d$ |
| Description: | Max. historical ammonia flow rate to the ammonia oxidation reactor Hu-Chems II |
| Source of data used: | According to PDD |
| Value(s) : | **91.82 $tNH_3/d$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

**Data and parameter not monitored for Hu-Chems III**

| **Data / Parameter:** | **EF_HC,III** |
|---|---|
| Data unit: | $tCO_2e/t$ |
| Description: | Hydrocarbon $CO_2$ emission factor Hu-Chems III |
| Source of data used: | According to the PDD |
| Value(s) : | **3.0 $tCO_2e/t$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **OXID_HC,III** |
|---|---|
| Data unit: | % |
| Description: | Hydrocarbon oxidation factor Hu-Chems III |
| Source of data used: | According to the PDD;<br>According to AM0028 OXID_HC,III is 100% (conservative approach) |
| Value(s) : | **100%** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **Type_HC,III** |
|---|---|
| Data unit: | - |
| Description: | Type of hydrocarbon |
| Source of data used: | Hydrocarbon supplier |
| Value(s) : | **Propane** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **P_HNO3,hist,III** |
|---|---|
| Data unit: | $tHNO_3$ |
| Description: | Design capacity |
| Source of data used: | According to PDD |
| Value(s) : | **116,800 $tHNO_3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **T_g,hist,III** |
|---|---|

| | |
|---|---|
| Data unit: | °C |
| Description: | Historical operating temperature of the ammonia oxidation reactor Hu-Chems III |
| Source of data used: | According to PDD |
| Value(s) : | **880 – 910 °C** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **P_g,hist,III** |
|---|---|
| Data unit: | barg |
| Description: | Historical operating pressure of the ammonia oxidation reactor Hu-Chems III |
| Source of data used: | According to PDD |
| Value(s) : | **5.0 – 9.8 barg** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **G_sup,hist,III** |
|---|---|
| Data unit: | - |
| Description: | Historical supplier of the ammonia oxidation catalyst Hu-Chems III |
| Source of data used: | According to PDD |
| Value(s) : | **Johnson Matthey** and/or **Umicore** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **G_com,hist,III** |
|---|---|
| Data unit: | % |
| Description: | Historical composition of the ammonia oxidation catalyst Hu-Chems III and Hu Chems III |
| Source of data used: | According to PDD |
| Value(s) : | **90% Pt**<br>**5% Rh**<br>**5% Pd** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **A_OR,hist,III** |
|---|---|
| Data unit: | $tNH_3/d$ |
| Description: | Max. historical ammonia flow rate to the ammonia oxidation reactor Hu-Chems III |
| Source of data used: | According to PDD |
| Value(s) : | **92.57 $tNH_3/d$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

**Data and parameter not monitored for Hu-Chems IV**

| **Data / Parameter:** | **P_HNO3,hist,IV** |
|---|---|
| Data unit: | $tHNO_3$ |
| Description: | Design capacity |
| Source of data used: | According to PDD |
| Value(s) : | **467,200 $tHNO_3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **T_g,hist,IV** |
|---|---|
| Data unit: | °C |
| Description: | Historical operating temperature of the ammonia oxidation reactor Hu-Chems IV |
| Source of data used: | According to PDD |
| Value(s) : | **860 – 910 °C** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **P_g,hist,IV** |
|---|---|
| Data unit: | barg |
| Description: | Historical operating pressure of the ammonia oxidation reactor Hu-Chems IV |
| Source of data used: | According to PDD |
| Value(s) : | **2.2 barg – 4.4 barg** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **G_sup,hist,IV** |
|---|---|
| Data unit: | - |
| Description: | Historical supplier of the ammonia oxidation catalyst Hu-Chems IV |
| Source of data used: | According to PDD |
| Value(s) : | **Johnson Matthey** and/or **Umicore** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **G_com,hist,IV** |
|---|---|
| Data unit: | % |
| Description: | Historical composition of the ammonia oxidation catalyst Hu-Chems IV |
| Source of data used: | According to PDD |
| Value(s) : | **95% Pt**<br>**5% Rh**<br>and / or<br>**92% Pt**<br>**8% Rh** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| **Data / Parameter:** | **A_OR,hist,IV** |
|---|---|
| Data unit: | $tNH_3/d$ |
| Description: | Max. historical ammonia flow rate to the ammonia oxidation reactor Hu-Chems III |
| Source of data used: | According to PDD |
| Value(s) : | **355.50 $tNH_3/d$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Additional comment: | - |

| D.2. Data and parameters monitored |
|---|

**Data and parameter monitored relevant for all plants (Hu-Chems II, Hu-chems III and Hu-Chems IV)**

| **Data / Parameter:** | **PE_y** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **9,233 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **PE_ND,y** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions from $N_2O$ not destroyed |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **8,733 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, | - |

| | |
|---|---|
| accuracy class, serial number, calibration frequency, date of last calibration, validity) | |
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **PE_DF,y** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions from destruction facility |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **500 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **BE_y** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Baseline emissions |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **381,139 $tCO_2e$** |
| Indicate what the data are | Baseline emission calculations |

| | |
|---|---|
| used for (Baseline/ Project/ Leakage emission calculations) | |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **REG_NOx** |
|---|---|
| Data unit: | tNOx/m³ |
| Description: | National regulation on $NO_x$ emissions |
| Measured /Calculated /Default: | - |
| Source of data: | Regional authorities: Official notification local authorities |
| Value(s) of monitored parameter: | **200 ppmv**<br><br>**Comment:**<br>$NO_x$ emissions are measured at the outlet of the EnviNOx® systems. The continuous measurement of the $NO_x$ concentration reports the following concentrations:<br>• Hu-Chems II: 4.6 ppm<br>• Hu-Chems III: 2.7 ppm<br>• Hu-Chems IV: 22.8 ppm |
| Indicate what the data are used for (Baseline/Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | - |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **QR_N2O,y**<br>**RSE_N2O,y**<br>**CR_N2O** |
|---|---|

| | |
|---|---|
| Data unit: | $tN_2O$<br>$tN_2O/t\ HNO_3$<br>$tN_2O/m^3$ |
| Description: | National regulation on $N_2O$ emissions |
| Measured /Calculated /Default: | Actual no regulations on $N_2O$ emissions are in place |
| Source of data: | Regional authorities |
| Value(s) of monitored parameter: | Actual no regulations on $N_2O$ emissions are in place, therefore **no regulation is applicable** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | - |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

**Data and parameter monitored Hu-Chems II:**

| **Data / Parameter:** | **PE_y,II** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions Hu-Chems II |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **2,551 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **PE_ND,II** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions from $N_2O$ not destroyed Hu-Chems II |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **2,325 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |

| | |
|---|---|
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **PE_DF,II** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions from destruction facility Hu-Chems II |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **226 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **PE_$N_2O$,II** |
|---|---|
| Data unit: | $tN_2O$ |
| Description: | $N_2O$ not destroyed by facility Hu-Chems II |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **7.50 $tN_2O$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, | - |

| | |
|---|---|
| accuracy class, serial number, calibration frequency, date of last calibration, validity) | |
| Measuring/ Reading/ Recording frequency: | Recording: Daily |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **F_TG,II** |
|---|---|
| Data unit: | $Nm^3/h$ |
| Description: | Volume flow tail gas at $N_2O$ destruction facility interval i Hu-Chems II |
| Measured /Calculated /Default: | Measured |
| Source of data: | Flow meter / Monitoring system (Delta V)<br>Flow metering system automatically records volume flow adjusted to standard temperature and pressure.<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **74,248,292 $Nm^3$**<br>**(38,371 $Nm^3/h$)** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline and project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Venturi tube, designed and manufactured in accordance with ISO 5167-4:2003<br>Standard Normal Conditions: 1,013.25 hPa, 273.15K)<br><br>**322-FT-2-5130B/5184B**<br>Type: Differential pressure transmitter<br>Accuracy class: ± 0.1% of span<br>Serial number: 01990156/01990157<br>Calibration frequency: 24 months<br>Date of last calibration: 23 February 2009<br>Validity: 22 February 2011<br><br>**322-TT-2-1136/1137**<br>Type: Temperature transmitter<br>Accuracy class: ± 0.15% of span<br>Serial number: 01990158/ 01990159<br>Calibration frequency: 24 months<br>Date of last calibration: 23 February 2009<br>Validity: 22 February 2011<br><br>**322-PT-2-3133/3134**<br>Type: Pressure transmitter |

| | |
|---|---|
| | Accuracy class: ± 0.1% of span<br>Serial number: 5435394/5435395<br>Calibration frequency: 24 months<br>Date of last calibration: 23 February 2009<br>Validity: 22 February 2011 |
| Measuring/ Reading/ Recording frequency: | Measuring: Continuously<br>Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*.<br><br>Plausibility check of measured values is regularly done with recorded values of the redundantly installed instruments. |

| **Data / Parameter:** | **CO_N2O,II** |
|---|---|
| Data 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 photometry for $N_2O$ / Monitoring system (Delta V)<br><br>In the effluent of the EnviNOx®- system, the concentrations of nitrous oxide ($N_2O$) is analysed continuously. Analysis is done by using non-dispersive infrared photometry for $N_2O$.<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **1.01E-07 $tN_2O/Nm^3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial | **322-AI-2-0127**<br>Type: NDIR Analyzer |

| | |
|---|---|
| number, calibration frequency, date of last calibration, validity) | Accuracy class: ±1% (zero/span)<br>Serial number: 990861497812<br>Calibration frequency:<br>Zero calibration daily (automatically)<br>Span calibration every two days (automatically)<br>Third party analyser certification frequency: 24 months<br>Latest third party analyser certification: 31/07/2008 and 12/05/2010, respectively (by governmental Korean Testing laboratory)<br>Validity: 30/07/2010 and 11/05/2012, respectively |
| Measuring/ Reading/ Recording frequency: | Measuring: Continuously<br>Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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.<br><br>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*.<br><br>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).<br><br>Certified (Certificates confirming stability of standard gas during monitoring period and 1% uncertainty) standard gases are used for self calibration.<br><br>Sample line testing is done annually by applying certified standard gas at the beginning of the sample line. Latest test has been conducted on 29/06/2009 and 16/06/2010, with positive results.<br><br>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 January 2010. |

| | |
|---|---|
| **Data / Parameter:** | **M_i,II** |

| | |
|---|---|
| Data unit: | H |
| Description: | Measuring Interval |
| Measured /Calculated /Default: | Measured |
| Source of data: | Monitoring system (Delta V) |
| Value(s) of monitored parameter: | **10 sec** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline and project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Measuring: Continuously<br>Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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.<br><br>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*.<br><br>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. |

| **Data / Parameter:** | **PE_HC,II** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Emissions from hydrocarbon use in destruction facility Hu-Chems II |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **226 $tCO_2e$** |

| | |
|---|---|
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **HCE_C, II** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Converted hydrocarbon emissions Hu-Chems II |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **226 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **Q_HC,II** |
|---|---|
| Data unit: | $Nm^3$ |
| Description: | Hydrocarbon input (propane as reducing agent) Hu-Chems II |
| Measured /Calculated /Default: | Measured |
| Source of data: | Flow meter / Monitoring System (Delta V) |

| | |
|---|---|
| | The propane used as reducing agent is measured by standard flow meters. Flow is converted to standard conditions based on temperature and pressure measurement.<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **37,553 $Nm^3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **322-FT-2-5121**<br>Type: Coriolis flow meter<br>Accuracy class: ± 0.35%<br>Serial number: 14126211<br>Calibration frequency: 60 months<br>Date of last calibration: 16/02/2009<br>Validity: 15/02/2014<br><br>**322-TT-2-1119**<br>Type: Temperature transmitter<br>Accuracy class: ± 0.15% of span<br>Serial number: 01545263<br>Calibration frequency: 48 months<br>Date of last calibration: 10/03/2009<br>Validity: 09/03/2013<br><br>**322-PT-2-3118**<br>Type: Pressure transmitter<br>Accuracy class: ± 0.1% of span<br>Serial number: 5239384<br>Calibration frequency: 48 months<br>Date of last calibration: 30/12/2008<br>Validity: 29/12/2012 |
| Measuring/ Reading/ Recording frequency: | Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*. |

| **Data / Parameter:** | **ρ_HC,II** |
|---|---|
| Data unit: | t / Nm³ |
| Description: | Hydrocarbon density Hu-Chems II |
| Measured /Calculated /Default: | Default |
| Source of data: | Default value / Supplier certificates |
| Value(s) of monitored parameter: | **2.00E-3 t/Nm³**<br>Standard Normal Conditions: 1,013.25 hPa, 273.15K<br><br>For calculation of project emissions, a hydrocarbon density value of $2.00*10^{-3}$ t/Nm³ is applied (as traceable in the excel books, *Annex 2*). According to supplier certificates, actual density of the delivered hydrocarbon is below the applied density. Thus, applied density is conservative. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Yearly |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **P_HNO3,II** |
|---|---|
| Data unit: | t$HNO_3$ |
| Description: | Plant output of $HNO_3$ Hu-Chems II |
| Measured /Calculated /Default: | Measured |
| Source of data: | Production reports<br><br>The nitric acid produced (recorded as 100% nitric acid) is determined from the volume flow measured with a flow meter. The hourly volume flow rate is available in the Hu-Chems Fine Chemical distributed control system (DCS).<br><br>The concentration and density of the acid is determined by laboratory analysis three times daily following the respective ISO QM procedure. The daily average of the nitric acid concentration and density are |

<table>
<tr><td></td><td>calculated and used for the specific day.<br><br>The DCS generates daily reports including the daily nitric acid production.<br><br>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 AM0028 in an overall format.<br><br>The excel book containing 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.</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>24,246 t$HNO_3$<br><br><table><tr><td>Nitric Acid produced from 22/01/2009* until 21/01/2010</td><td>84,434</td></tr><tr><td>Nitric Acid produced from 22/01/2010* until 30/06/2010</td><td>44,396</td></tr><tr><td>Limit of annual Nitric Acid Production according to PDD</td><td>116,800</td></tr></table><br>* The calendar day, on which the crediting period has started is the 22/01/2007, therefore a year between 22/01 of a year and 21/01 of the subsequent year is considered as a “Crediting Year”.<br><br>The nitric acid production within the most recently started Crediting Year prior to the start of the covered monitoring period is compared with the limit of annual Nitric Acid Production as established in the PDD (P_HNO3,hist).<br><br>In the present case, the produced amount of nitric acid in the ongoing crediting year between 22/01/2010 until 30/06/2010 (end of monitoring period) has been compared with P_HNO3,hist,II. The production in this crediting year is below the limit in Hu-Chems II. Furthermore, the production in the crediting year from 22/01/2009 until 21/01/2010 was clearly below the limit in Hu-Chems II.<br><br>The assessment duly represents the production within a one-year production cycle.</td></tr>
<tr><td>Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Baseline emission calculations</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration</td><td>322-FT-2-512<br>Type: Magnetic Flowmeter<br>Accuracy class: ± 0.25%</td></tr>
</table>

| | |
|---|---|
| frequency, date of last calibration, validity) | Serial number: 0880153845<br>Calibration frequency: Instrument applied requires no regular calibration after factory calibration<br>Date of last calibration: 25/05/2009 (Factory calibration)<br>General maintenance frequency: 48 months from commissioning or latest general maintenance<br>Commissioning: 09/09/2009 Latest general maintenance: 15/06/2010<br>Validity of maintenance status: 08/09/2013 and 14/06/2014 respectively<br><br>**322-TT-2-127**<br>Type: Temperature Sensor<br>Accuracy class: ± 0.15% of span<br>Serial number has not been issued<br>Calibration frequency: 48 months<br>Date of last calibration: 23/07/2009<br>Validity: 22/07/2013 |
| Measuring/ Reading/ Recording frequency: | Recorded: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*.<br><br>Plausibility of nitric acid production data is regularly checked by nitrogen balance. During the actual monitoring period, the conversion rate of ammonia nitrogen to nitric acid is within a plausible range. |

| **Data / Parameter:** | **QI_N2O,II** |
|---|---|
| Data 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 (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |

| | |
|---|---|
| Value(s) of monitored parameter: | **284.87 $tN_2O$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Daily |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **CI_N2O,II** |
|---|---|
| Data unit: | $tN_2O$/ $Nm^3$ |
| Description: | $N_2O$ concentration at destruction facility inlet Hu-Chems II |
| Measured /Calculated /Default: | Measured |
| Source of data: | Non-dispersive infrared photometry for $N_2O$ / Monitoring system (Delta V)<br><br>In the feed of the EnviNOx®- system, the concentrations of nitrous oxide ($N_2O$) is analysed continuously. Analysis is done by using non-dispersive infrared photometry for $N_2O$.<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **3.84E-06 $tN_2O/Nm^3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **322-AI-2-0125**<br>Type: NDIR Analyzer<br>Accuracy class: ±1% (zero/span)<br>Serial number: 370861495671<br>Calibration frequency:<br>Zero calibration daily (automatically)<br>Span calibration every two days (automatically)<br>Third party analyser certification frequency: 24 months<br>Latest third party analyser certification: 31/07/2008 and 12/05/2010, respectively (by governmental Korean Testing laboratory)<br>Validity: 30/07/2010 and 11/05/2012, respectively |

| | |
|---|---|
| Measuring/ Reading/ Recording frequency: | Measuring: Continuously<br>Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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.<br><br>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*.<br><br>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).<br><br>Certified (Certificates confirming stability of standard gas during monitoring period and 1% uncertainty) standard gases are used for self calibration.<br><br>Sample line testing is done annually by applying certified standard gas at the beginning of the sample line. Latest test has been conducted on 29/06/2009 and 16/06/2010, with positive results.<br><br>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 January 2010. |

| **Data / Parameter:** | **T_g,II** |
|---|---|
| Data unit: | °C |
| Description: | Actual operating temperature ammonia oxidation reactor Hu-Chems II during a day d |
| Measured /Calculated /Default: | Measured |
| Source of data: | Temperature transmitter / Monitoring System (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |

| | |
|---|---|
| Value(s) of monitored parameter: | **901.2 °C**<br><br>The temperature in the ammonia oxidation reactor (AOR) is monitored by two thermocouples. The operating temperatures in the AOR are collected, subsequently the Delta-V system automatically calculates and reports the average temperature.<br>An excel book containing these daily average values and automatic checks, if daily average values are within the permitted range, is attached as *Annex 2* to this Monitoring Report.<br><br>The actual average daily operating temperature in the AOR is within the permitted range for all days covered by this monitoring period. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **322-TT-2-115/116**<br>Type: Temperature transmitter<br>Accuracy class: ± 0.15% of span<br>Serial number: 1820884 / 1784582<br>Calibration frequency: 48 months<br>Date of last calibration: 10/03/2009<br>Validity: 09/03/2013 |
| Measuring/ Reading/ Recording frequency: | Recording: Continuously |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*. |

| **Data / Parameter:** | **P_g,II** |
|---|---|
| Data unit: | Barg |
| Description: | Actual operating pressure ammonia oxidation reactor Hu-Chems II |
| Measured /Calculated /Default: | Measured |

| | |
|---|---|
| Source of data: | Pressure transmitter / Monitoring System (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **8.45 barg**<br><br>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.<br>An excel book containing daily average values and automatic checks, if daily average values are within the permitted range, is attached as *Annex 2* to this Monitoring Report.<br><br>The actual average daily operating pressure in the AOR is within the permitted range for all days covered by this monitoring period. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **322-PT-2-304**<br>Type: Pressure transmitter<br>Accuracy class: : ± 0.25% of span<br>Serial number: 1094015<br>Calibration frequency: 48 Months<br>Date of last calibration: 12/05/2009<br>Validity: 11/05/2013 |
| Measuring/ Reading/ Recording frequency: | Recording: Continuously |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*. |

| **Data / Parameter:** | **G_sup,II** |
|---|---|
| Data unit: | - |
| Description: | Supplier of the ammonia oxidation catalyst Hu-Chems II |

| | |
|---|---|
| Measured /Calculated /Default: | - |
| Source of data: | Supplier according to commercial invoice |
| Value(s) of monitored parameter: | **Johnson Matthey**<br><br>The supplier of the ammonia oxidation catalyst is the same as prior to the start of the project activity (G_sup,hist,II) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Every gauze change<br><br>Latest gauze changes, relevant to the monitoring period:<br>07/01/2010<br>08/04/2010 |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **G_com,II** |
|---|---|
| Data unit: | % |
| Description: | Composition of the ammonia oxidation catalyst Hu-Chems II |
| Measured /Calculated /Default: | - |
| Source of data: | Composition according to catalyst supplier information |
| Value(s) of monitored parameter: | **90% Pt**<br>**5% Rh**<br>**5% Pd**<br><br>The composition of the ammonia oxidation catalyst is the same kind of catalyst composition already in use prior to the start of the project activity. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |

| | |
|---|---|
| Measuring/ Reading/ Recording frequency: | Every gauze change<br><br>Latest gauze changes, relevant to the monitoring period:<br>07/01/2010<br>08/04/2010 |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **SE_N2O,II** |
|---|---|
| Data 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 system (Delta V) / Production Reports<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **0.012 $tN_2O/tHNO_3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Yearly / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **A_OR,d,II** |
|---|---|
| Data unit: | $tNH_3/d$ |
| Description: | Actual ammonia flow rate to the ammonia oxidation reactor Hu-Chems II |
| Measured /Calculated /Default: | Measured |
| Source of data: | Flow meter / Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **82.74 $tNH_3/d$**<br><br>An excel book containing daily values and automatic checks, if daily |

| | |
|---|---|
| | values are within the permitted range, is attached as *Annex 2* to this Monitoring Report.<br><br>The actual daily ammonia flow rate to the AOR is within the permitted range for all days covered by this monitoring period. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **322-FT-2-503**<br>Type: Differential pressure transmitter<br>Accuracy class: : ± 0.5% of span<br>Serial number: 2052133<br>Calibration frequency: 48 Months<br>Date of last calibration: 25/06/2009<br>Validity: 24/06/2013<br><br>**322-TT-2-103**<br>Type: Temperature transmitter<br>Accuracy class: : ± 0.15% of span<br>Serial number: 1809806<br>Calibration frequency: 48 Months<br>Date of last calibration: 18/03/2009<br>Validity: 17/03/2013<br><br>**322-PT-2-303**<br>Type: Pressure transmitter<br>Accuracy class: : ± 0.1% of span<br>Serial number: 2052135<br>Calibration frequency: 48 Months<br>Date of last calibration: 25/06/2009<br>Validity: 24/06/2013 |
| Measuring/ Reading/ Recording frequency: | Recording: Continuously |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*.<br><br>Plausibility of ammonia input data is regularly checked by nitrogen balance. During the actual monitoring period, the conversion rate of ammonia nitrogen to nitric acid is within a plausible range. |

**Data and parameter monitored Hu-Chems III:**

| **Data / Parameter:** | **PE_y,III** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions Hu-Chems III |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **2,104 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **PE_ND,III** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions from $N_2O$ not destroyed Hu-Chems III |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **1,830 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |

| | |
|---|---|
| Measuring/ Reading/ Recording frequency: | Recording: Anually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **PE_DF,III** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions from destruction facility Hu-Chems III |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **274 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Anually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **PE_$N_2O$,III** |
|---|---|
| Data unit: | $tN_2O$ |
| Description: | $N_2O$ not destroyed by facility Hu-Chems III |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **5.90 $tN_2O$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, | - |

| | |
|---|---|
| accuracy class, serial number, calibration frequency, date of last calibration, validity) | |
| Measuring/ Reading/ Recording frequency: | Recording: Daily |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **F_TG,III** |
|---|---|
| Data unit: | $Nm^3/h$ |
| Description: | Volume flow tail gas at $N_2O$ destruction facility interval i Hu-Chems III |
| Measured /Calculated /Default: | Measured |
| Source of data: | Flow meter / Monitoring system (Delta V)<br>Flow metering system automatically records volume flow adjusted to standard temperature and pressure.<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **86,862,799 $Nm^3$**<br>**(40,590 $Nm^3/h$)** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline and project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Venturi tube, designed and manufactured in accordance with ISO 5167-4:2003<br>Standard Normal Conditions: 1,013.25 hPa, 273.15K)<br><br>**323-FT-3-5130B/3184B**<br>Type: Differential pressure transmitter<br>Accuracy class: ± 0.1% of span<br>Serial number: 01885789/ 01885790<br>Calibration frequency: 24 months<br>Date of last calibration: 29/12/2008<br>Validity: 28/12/2010<br><br>**323-TT-3-1136/1137**<br>Type: Temperature transmitter<br>Accuracy class: ± 0.15% of span<br>Serial number: 01885793/ 01885794<br>Calibration frequency: 24 months<br>Date of last calibration: 09/03/2009<br>Validity: 08/03/2011<br><br>**323-PT-3-3133/3134** |

| | |
|---|---|
| | Type: Pressure transmitter<br>Accuracy class: ± 0.1% of span<br>Serial number: 5389822/ 5389823<br>Calibration frequency: 24 months<br>Date of last calibration: 29/12/2008<br>Validity: 28/12/2010 |
| Measuring/ Reading/ Recording frequency: | Measuring: Continuously<br>Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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 Accordingly, calibration and maintenance are part of regular QA/QC of the nitric acid plant (please refer also to section C-3).<br><br>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*.<br><br>Plausibility check of measured values is regularly done with recorded values of the redundantly installed instruments. |

| **Data / Parameter:** | **CO_N2O,III** |
|---|---|
| Data 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 photometry for $N_2O$ / Monitoring system (Delta V)<br><br>In the effluent of the EnviNOx®- system, the concentrations of nitrous oxide ($N_2O$) is analysed continuously. Analysis is done by using non-dispersive infrared photometry for $N_2O$.<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **6.80E-08 $tN_2O/Nm^3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, | **323-AI-3-0127** |

| | |
|---|---|
| accuracy class, serial number, calibration frequency, date of last calibration, validity) | Type: NDIR Analyzer<br>Accuracy class: ±1% (zero/span)<br>Serial number: 990861497815<br>Calibration frequency:<br>Zero calibration daily (automatically)<br>Span calibration every two days (automatically)<br>Third party analyser certification frequency: 24 months<br>Latest third party analyser certification: 31/07/2008 and 13/05/2010, respectively (by governmental Korean Testing laboratory)<br>Validity: 30/07/2010 and 12/05/2012, respectively |
| Measuring/ Reading/ Recording frequency: | Measuring: Continuously<br>Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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.<br><br>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*.<br><br>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).<br><br>Certified (Certificates confirming stability of standard gas during monitoring period and 1% uncertainty) standard gases are used for self calibration.<br><br>Sample line testing is done annually by applying certified standard gas at the beginning of the sample line. Latest test has been conducted on 29/06/2009 and 16/06/2010, with positive results.<br><br>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 January 2010. |

| **Data / Parameter:** | **M_i,III** |
|---|---|
| Data unit: | h |
| Description: | Measuring Interval |
| Measured /Calculated /Default: | Measured |
| Source of data: | Monitoring system (Delta V) |
| Value(s) of monitored parameter: | **10 sec** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline and project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Measuring: Continuously<br>Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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.<br><br>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*.<br><br>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. |

| **Data / Parameter:** | **PE_HC,III** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Emissions from hydrocarbon use in destruction facility Hu-Chems III |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored | **274 $tCO_2e$** |

| | |
|---|---|
| parameter: | |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Anually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **HCE_C, III** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Converted hydrocarbon emissions Hu-Chems III |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **274 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Anually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **Q_HC,III** |
|---|---|
| Data unit: | $Nm^3$ |
| Description: | Hydrocarbon input (propane as reducing agent) Hu-Chems III |
| Measured /Calculated /Default: | Measured |
| Source of data: | Flow meter / Monitoring System (Delta V) |

| | |
|---|---|
| | The propane used as reducing agent is measured by standard flow meters. Flow is converted to standard conditions based on temperature and pressure measurement.<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **45,535 $Nm^3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **323-FT-3-5121**<br>Type: Coriolis flow meter<br>Accuracy class: ± 0.35%<br>Serial number: 14125454<br>Calibration frequency: 60 months<br>Date of last calibration: 13/02/2009<br>Validity: 12/02/2014<br><br>**323-TT-3-1119**<br>Type: Temperature transmitter<br>Accuracy class: ± 0.15% of span<br>Serial number: 01545265<br>Calibration frequency: 48 months<br>Date of last calibration: 09/03/2009<br>Validity: 08/03/2013<br><br>**323-PT-3-3118**<br>Type: Pressure transmitter<br>Accuracy class: ± 0.1% of span<br>Serial number: 5239388<br>Calibration frequency: 48 months<br>Date of last calibration: 29/12/2008<br>Validity: 28/12/2012 |
| Measuring/ Reading/ Recording frequency: | Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*. |

| **Data / Parameter:** | **ρ_HC,III** |
|---|---|
| Data unit: | t / Nm³ |
| Description: | Hydrocarbon density Hu-Chems III |
| Measured /Calculated /Default: | Default |
| Source of data: | Default value / Supplier certificates |
| Value(s) of monitored parameter: | **2.00E-3 t/Nm³**<br>Standard Normal Conditions: 1,013.25 hPa, 273.15K<br><br>For calculation of project emissions, a hydrocarbon density value of $2.00*10^{-3}$ t/Nm³ is applied (as traceable in the excel books, *Annex 2*). According to supplier certificates, actual density of the delivered hydrocarbon is below the applied density. Thus, applied density is conservative. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Yearly |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **P_HNO3,III** |
|---|---|
| Data unit: | t$HNO_3$ |
| Description: | Plant output of $HNO_3$ Hu-Chems III |
| Measured /Calculated /Default: | Measured |
| Source of data: | Production reports<br><br>The nitric acid produced (recorded as 100% nitric acid) is determined from the volume flow measured with a flow meter. The hourly volume flow rate is available in the Hu-Chems Fine Chemical distributed control system (DCS).<br><br>The concentration and density of the acid is determined by laboratory analysis three times daily following the respective ISO QM procedure. The daily average of the nitric acid concentration and density are |

<table>
<tr><td></td><td>calculated and used for the specific day.<br><br>The DCS generates daily reports including the daily nitric acid production.<br><br>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 AM0028 in an overall format.<br><br>The excel book containing 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.</td></tr>
<tr><td>Value(s) of monitored parameter:</td><td>26,620 t$HNO_3$<br><br><table><tr><td>Nitric Acid produced from 22/01/2009* until 21/01/2010</td><td>92,985</td></tr><tr><td>Nitric Acid produced from 22/01/2010* until 30/06/2010</td><td>47,000</td></tr><tr><td>Limit of annual Nitric Acid Production according to PDD</td><td>116,800</td></tr></table><br>* The calendar day, on which the crediting period has started is the 22/01/2007, therefore a year between 22/01 of a year and 21/01 of the subsequent year is considered as a “Crediting Year”.<br><br>The nitric acid production within the most recently started Crediting Year prior to the start of the covered monitoring period is compared with the limit of annual Nitric Acid Production as established in the PDD (P_HNO3,hist).<br><br>In the present case, the produced amount of nitric acid in the ongoing crediting year between 22/01/2010 until 30/06/2010 (end of monitoring period) has been compared with P_HNO3,hist,III. The production in this crediting year is below the limit in Hu-Chems III. Furthermore, the production in the crediting year from 22/01/2009 until 21/01/2010 was clearly below the limit in Hu-Chems III.<br><br>The assessment duly represents the production within a one-year production cycle.</td></tr>
<tr><td>Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)</td><td>Baseline emission calculations</td></tr>
<tr><td>Monitoring equipment (type, accuracy class, serial number, calibration</td><td>323-FT-3-512<br>Type: Magnetic Flowmeter<br>Accuracy class: ± 0.25%</td></tr>
</table>

| | |
|---|---|
| frequency, date of last calibration, validity) | Serial number: 06011873<br>Calibration frequency: Instrument applied requires no regular calibration after factory calibration<br>Date of last calibration (Factory calibration): 19/01/2010<br>General maintenance frequency: 48 months from commissioning or latest general maintenance<br>Commissioning: 10/02/2010<br>Validity of maintenance status: 09/02/2014<br><br>**323-TT-3-127**<br>Type: Temperature Sensor<br>Accuracy class: ± 0.15% of span<br>Serial number has not been issued<br>Calibration frequency: 48 months<br>Date of last calibration: 23/07/2009<br>Validity: 22/07/2013 |
| Measuring/ Reading/ Recording frequency: | Recorded: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*.<br><br>Plausibility of nitric acid production data is regularly checked by nitrogen balance. During the actual monitoring period, the conversion rate of ammonia nitrogen to nitric acid is within a plausible range. |

| **Data / Parameter:** | **QI_N2O,III** |
|---|---|
| Data 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 (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **317.21 $tN_2O$** |

| | |
|---|---|
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Daily |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **CI_N2O,III** |
|---|---|
| Data unit: | $tN_2O$/ $Nm^3$ |
| Description: | $N_2O$ concentration at destruction facility inlet Hu-Chems III |
| Measured /Calculated /Default: | Measured |
| Source of data: | Non-dispersive infrared photometry for $N_2O$ / Monitoring system (Delta V)<br><br>In the feed of the EnviNOx®- system, the concentrations of nitrous oxide ($N_2O$) is analysed continuously. Analysis is done by using non-dispersive infrared photometry for $N_2O$.<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **3.65E-06 $tN_2O/Nm^3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **323-AI-3-0125**<br>Type: NDIR Analyzer<br>Accuracy class: ±1% (zero/span)<br>Serial number: 370861497814<br>Calibration frequency:<br>Zero calibration daily (automatically)<br>Span calibration every two days (automatically)<br>Third party analyser certification frequency: 24 months<br>Latest third party analyser certification: 31/07/2008 and 13/05/2010, respectively (by governmental Korean Testing laboratory)<br>Validity: 30/07/2010 and 12/05/2012, respectively |
| Measuring/ Reading/ Recording frequency: | Measuring: Continuously<br>Recording: Daily |

| | |
|---|---|
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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.<br><br>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*.<br><br>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).<br><br>Certified (Certificates confirming stability of standard gas during monitoring period and 1% uncertainty) standard gases are used for self calibration.<br><br>Sample line testing is done annually by applying certified standard gas at the beginning of the sample line. Latest test has been conducted on 29/06/2009 and 16/06/2010, with positive results.<br><br>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 January 2010. |

| **Data / Parameter:** | **T_g,III** |
|---|---|
| Data unit: | °C |
| Description: | Actual operating temperature ammonia oxidation reactor Hu-Chems III |
| Measured /Calculated /Default: | Measured |
| Source of data: | Temperature transmitter / Monitoring System (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **899.9 °C**<br><br>The temperature in the ammonia oxidation reactor (AOR) is monitored |

| | |
|---|---|
| | by two thermocouples. The operating temperatures in the AOR are collected, subsequently the Delta-V system automatically calculates and reports the average temperature.<br>An excel book containing these daily average values and automatic checks, if daily average values are within the permitted range, is attached as *Annex 2* to this Monitoring Report.<br><br>The actual average daily operating temperature in the AOR is within the permitted range for all days covered by this monitoring period. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **323-TT-3-115/116**<br>Type: Temperature transmitter<br>Accuracy class: ± 0.15% of span<br>Serial number: 1730211/ 1784581<br>Calibration frequency: 48 months<br>Date of last calibration: 09/03/2009<br>Validity: 08/03/2013 |
| Measuring/ Reading/ Recording frequency: | Recording: Continuously |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*. |

| **Data / Parameter:** | **P_g,III** |
|---|---|
| Data unit: | barg |
| Description: | Actual operating pressure ammonia oxidation reactor Hu-Chems III |
| Measured /Calculated /Default: | Measured |
| Source of data: | Pressure transmitter / Monitoring System (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this |

| | |
|---|---|
| | Monitoring Report. |
| Value(s) of monitored parameter: | **8.94 barg**<br><br>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.<br>An excel book containing daily average values and automatic checks, if daily average values are within the permitted range, is attached as *Annex 2* to this Monitoring Report.<br><br>The actual average daily operating pressure in the AOR is within the permitted range for all days covered by this monitoring period. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **323-PT-3-304**<br>Type: Pressure transmitter<br>Accuracy class: : ± 0.25% of span<br>Serial number: 720761910698<br>Calibration frequency: 48 Months<br>Date of last calibration: 09/05/2009<br>Validity: 08/05/2013 |
| Measuring/ Reading/ Recording frequency: | Recording: Continuously |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*. |

| **Data / Parameter:** | **G_sup,III** |
|---|---|
| Data unit: | - |
| Description: | Supplier of the ammonia oxidation catalyst Hu-Chems III |
| Measured /Calculated /Default: | - |
| Source of data: | Supplier according to commercial invoice |

| | |
|---|---|
| Value(s) of monitored parameter: | **Johnson Matthey**<br><br>The supplier of the ammonia oxidation catalyst is the same as prior to the start of the project activity (G_sup,hist,III) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Every gauze change<br><br>Latest gauze changes, relevant to the monitoring period:<br>10/02/2010<br>17/05/2010 |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **G_com,III** |
|---|---|
| Data unit: | % |
| Description: | Composition of the ammonia oxidation catalyst Hu-Chems III |
| Measured /Calculated /Default: | - |
| Source of data: | Composition according to catalyst supplier information |
| Value(s) of monitored parameter: | **90% Pt**<br>**5% Rh**<br>**5% Pd**<br><br>The composition of the ammonia oxidation catalyst is the same kind of catalyst composition already in use prior to the start of the project activity. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Every gauze change<br><br>Latest gauze changes, relevant to the monitoring period: |

| | |
|---|---|
| | 10/02/2010<br>17/05/2010 |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **SE_N2O,III** |
|---|---|
| Data 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 system (Delta V) / Production Reports<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **0.012 $tN_2O/tHNO_3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Yearly / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **A_OR,d,III** |
|---|---|
| Data unit: | $tNH_3/d$ |
| Description: | Actual ammonia flow rate to the ammonia oxidation reactor Hu-Chems III |
| Measured /Calculated /Default: | Measured |
| Source of data: | Flow meter / Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **83.78 $tNH_3/d$**<br><br>An excel book containing daily values and automatic checks, if daily values are within the permitted range, is attached as *Annex 2* to this Monitoring Report. |

| | |
|---|---|
| | The actual daily ammonia flow rate to the AOR is within the permitted range for all days covered by this monitoring period. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **323-FT-3-503**<br>Type: Differential pressure transmitter<br>Accuracy class: : ± 0.5% of span<br>Serial number: 2052134<br>Calibration frequency: 48 Months<br>Date of last calibration: 25/06/2009<br>Validity: 24/06/2013<br><br>**323-TT-3-103**<br>Type: Temperature transmitter<br>Accuracy class: : ± 0.15% of span<br>Serial number: 1809794<br>Calibration frequency: 48 Months<br>Date of last calibration: 18/03/2009<br>Validity: 17/03/2013<br><br>**323-PT-3-303**<br>Type: Pressure transmitter<br>Accuracy class: : ± 0.1% of span<br>Serial number: 2052136<br>Calibration frequency: 48 Months<br>Date of last calibration: 25/06/2009<br>Validity: 24/06/2013 |
| Measuring/ Reading/ Recording frequency: | Recording: continuously |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*.<br><br>Plausibility of ammonia input data is regularly checked by nitrogen |

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|---|---|
| | balance. During the actual monitoring period, the conversion rate of ammonia nitrogen to nitric acid is within a plausible range. |

**Data and parameter monitored Hu-Chems IV:**

| **Data / Parameter:** | **PE_y,IV** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions Hu-Chems IV |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **4,578 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **PE_ND,IV** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions from $N_2O$ not destroyed Hu-Chems IV |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **4,578 $tCO_2e$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |

| | |
|---|---|
| Measuring/ Reading/ Recording frequency: | Recording: Annually / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **PE_DF,IV** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Project emissions from destruction facility Hu-Chems IV |
| Measured /Calculated /Default: | - |
| Source of data: | - |
| Value(s) of monitored parameter: | **Not applicable (no hydrocarbon used)** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | - |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | - |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **PE_$N_2O$,IV** |
|---|---|
| Data unit: | $tN_2O$ |
| Description: | $N_2O$ not destroyed by facility Hu-Chems IV |
| Measured /Calculated /Default: | Calculated |
| Source of data: | Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **14.77 $tN_2O$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last | - |

| | |
|---|---|
| calibration, validity) | |
| Measuring/ Reading/ Recording frequency: | Recording: Daily |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **$F_{TG,IV}$** |
|---|---|
| Data unit: | $Nm^3/h$ |
| Description: | Volume flow tail gas at $N_2O$ destruction facility interval i Hu-Chems IV |
| Measured /Calculated /Default: | Measured |
| Source of data: | Flow meter / Monitoring system (Delta V)<br>Flow metering system automatically records volume flow adjusted to standard temperature and pressure.<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **329,637,568 $Nm^3$**<br>**(156,672 $Nm^3/h$)** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline and project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | Venturi tube, designed and manufactured in accordance with ISO 5167-4:2003<br>Standard Normal Conditions: 1,013.25 hPa, 273.15K)<br><br>**324-FT-4-4115B/4116B**<br>Type: Differential pressure transmitter<br>Accuracy class: ± 0.1% of span<br>Serial number: 01885787/ 01885788<br>Calibration frequency: 24 months<br>Date of last calibration: 29/01/2009<br>Validity: 28/01/2011<br><br>**324-TT-4-1111/1112**<br>Type: Temperature transmitter<br>Accuracy class: ± 0.15% of span<br>Serial number: 01885791 / 01885792<br>Calibration frequency: 24 months<br>Date of last calibration: 29/01/2009<br>Validity: 28/01/2011<br><br>**324-PT-4-3113/3114**<br>Type: Pressure transmitter<br>Accuracy class: ± 0.1% of span<br>Serial number: 5389820/5389821 |

| | |
|---|---|
| | Calibration frequency: 24 months<br>Date of last calibration: 29/01/2009<br>Validity: 28/01/2011 |
| Measuring/ Reading/ Recording frequency: | Measuring: Continuously<br>Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*.<br><br>Plausibility check of measured values is regularly done with recorded values of the redundantly installed instruments. |

| **Data / Parameter:** | **CO_N2O,IV** |
|---|---|
| Data 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 photometry for $N_2O$ / Monitoring system (Delta V)<br><br>In the effluent of the EnviNOx®- system, the concentrations of nitrous oxide ($N_2O$) is analysed continuously. Analysis is done by using non-dispersive infrared photometry for $N_2O$.<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **4.48E-08 $tN_2O/Nm^3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last | **324-AI-4-0107**<br>Type: NDIR Analyzer<br>Accuracy class: ±1% (zero/span)<br>Serial number: 990861497818 |

| | |
|---|---|
| calibration, validity) | Calibration frequency:<br>Zero calibration daily (automatically)<br>Span calibration every two days (automatically)<br>Third party analyser certification frequency: 24 months<br>Latest third party analyser certification: 31/07/2008 and 11/05/2010, respectively (by governmental Korean Testing laboratory)<br>Validity: 30/07/2010 and 10/05/2012, respectively |
| Measuring/ Reading/ Recording frequency: | Measuring: Continuously<br>Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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.<br><br>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*.<br><br>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).<br><br>Certified (Certificates confirming stability of standard gas during monitoring period and 1% uncertainty) standard gases are used for self calibration.<br><br>Sample line testing is done annually by applying certified standard gas at the beginning of the sample line. Latest test has been conducted on 29/06/2009 and 16/06/2010, with positive results.<br><br>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 January 2010. |

| **Data / Parameter:** | **M_i,IV** |
|---|---|
| Data unit: | h |
| Description: | Measuring Interval |

| | |
|---|---|
| Measured /Calculated /Default: | Measured |
| Source of data: | Monitoring system (Delta V) |
| Value(s) of monitored parameter: | **10 sec** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline and project emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Measured: Continuously<br>Recorded: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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.<br><br>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*.<br><br>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. |

| **Data / Parameter:** | **PE_HC,IV** |
|---|---|
| Data 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: | **Not applicable (no hydrocarbon used)** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | - |
| Monitoring equipment (type, | - |

| | |
|---|---|
| accuracy class, serial number, calibration frequency, date of last calibration, validity) | |
| Measuring/ Reading/ Recording frequency: | - |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **HCE_C, IV** |
|---|---|
| Data unit: | $tCO_2e$ |
| Description: | Converted hydrocarbon emissions Hu-Chems IV |
| Measured /Calculated /Default: | - |
| Source of data: | - |
| Value(s) of monitored parameter: | **Not applicable (no hydrocarbon used)** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | - |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | - |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **Q_HC,IV** |
|---|---|
| Data unit: | $Nm^3$ |
| Description: | Hydrocarbon input Hu-Chems IV |
| Measured /Calculated /Default: | - |
| Source of data: | - |
| Value(s) of monitored parameter: | **Not applicable (no hydrocarbon used)** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | - |
| Monitoring equipment (type, accuracy class, serial number, calibration | - |

| | |
|---|---|
| frequency, date of last calibration, validity) | |
| Measuring/ Reading/ Recording frequency: | - |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **P_HNO3,IV** |
|---|---|
| Data unit: | $tHNO_3$ |
| Description: | Plant output of $HNO_3$ Hu-Chems IV |
| Measured /Calculated /Default: | Measured |
| Source of data: | Production reports<br><br>The nitric acid produced (recorded as 100% nitric acid) is determined from the volume flow measured with a flow meter. The hourly volume flow rate is available in the Hu-Chems Fine Chemical distributed control system (DCS).<br><br>The concentration and density of the acid is determined by laboratory analysis three times daily following the respective ISO QM procedure. The daily average of the nitric acid concentration and density are calculated and used for the specific day.<br><br>The DCS generates daily reports including the daily nitric acid production.<br><br>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 AM0028 in an overall format.<br><br>The excel book containing 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. |
| Value(s) of monitored parameter: | **107,338 $tHNO_3$**<br><br>Nitric Acid produced from 22/01/2009* until 21/01/2010: **424,070**<br>Nitric Acid produced from 22/01/2010* until 30/06/2010: **192,846**<br>Limit of annual Nitric Acid Production according to PDD: **467,200**<br><br>* The calendar day, on which the crediting period has started is the 22/01/2007, therefore a year between 22/01 of a year and 21/01 of the subsequent 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 limit of annual Nitric Acid Production as established in the PDD (P_HNO3,hist).<br><br>In the present case, the produced amount of nitric acid in the ongoing crediting year between 22/01/2010 until 30/06/2010 (end of monitoring period) has been compared with P_HNO3,hist,IV. The production in this crediting year is below the limit in Hu-Chems IV. Furthermore, the production in the crediting year from 22/01/2009 until 21/01/2010 was clearly below the limit in Hu-Chems IV.<br><br>The assessment duly represents the production within a one-year production cycle. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **324FT-4-609**<br>Type: Magnetic Flowmeter<br>Accuracy class: ± 0.5%<br>Serial number: 0870173774<br>Calibration frequency: Instrument applied requires no regular calibration after factory calibration<br>Date of last calibration: 26/05/2009 (Factory calibration)<br>General maintenance frequency: 48 months from commissioning or latest general maintenance<br>Commissioning: 21/10/2009, latest General Maintenance: 06/05/2010<br>Validity of maintenance status: 20/10/2013 and 05/05/2014 respectively<br><br>**324-TT-4-237**<br>Type: Temperature Transmitter<br>Accuracy class: ± 0.15% of span<br>Serial number: 966595<br>Calibration frequency: 48 months<br>Date of last calibration: 23/07/2009<br>Validity: 22/07/2013 |
| Measuring/ Reading/ Recording frequency: | Recorded: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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 |

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|---|---|
| | refer also to section C-3).<br><br>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*.<br><br>Plausibility of nitric acid production data is regularly checked by nitrogen balance. During the actual monitoring period, the conversion rate of ammonia nitrogen to nitric acid is within a plausible range. |

| **Data / Parameter:** | **QI_N2O,IV** |
|---|---|
| Data 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 (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **627.40 $tN_2O$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Daily |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **CI_N2O,IV** |
|---|---|
| Data unit: | $tN_2O$/ $Nm^3$ |
| Description: | $N_2O$ concentration at destruction facility inlet Hu-Chems IV |
| Measured /Calculated /Default: | Measured |
| Source of data: | Non-dispersive infrared photometry for $N_2O$ / Monitoring system (Delta V)<br><br>In the feed of the EnviNOx®- system, the concentrations of nitrous |

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|---|---|
| | oxide ($N_2O$) is analysed continuously. Analysis is done by using non-dispersive infrared photometry for $N_2O$.<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **1.90E-06 $tN_2O/Nm^3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **324-AI-4-0108**<br>Type: NDIR Analyzer<br>Accuracy class: ±1% (zero/span)<br>Serial number: 370861497817<br>Calibration frequency:<br>Zero calibration daily (automatically)<br>Span calibration every two days (automatically)<br>Third party analyser certification frequency: 24 months<br>Latest third party analyser certification: 31/07/2008 and 11/05/2010, respectively (by governmental Korean Testing laboratory)<br>Validity: 30/07/2010 and 10/05/2012, respectively |
| Measuring/ Reading/ Recording frequency: | Measuring: Continuously<br>Recording: Daily |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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.<br><br>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*.<br><br>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).<br><br>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 test has been conducted on 29/06/2009 and 16/06/2010, with positive results.<br><br>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 January 2010. |

| **Data / Parameter:** | **T_g,IV** |
|---|---|
| Data unit: | °C |
| Description: | Actual operating temperature ammonia oxidation reactor Hu-Chems IV |
| Measured /Calculated /Default: | Measured |
| Source of data: | Temperature transmitter / Monitoring System (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **897.3 °C**<br><br>The temperature in the ammonia oxidation reactor (AOR) is monitored by two thermocouples. The operating temperatures in the AOR are collected, subsequently the Delta-V system automatically calculates and reports the average temperature.<br>An excel book containing these daily average values and automatic checks, if daily average values are within the permitted range, is attached as *Annex 2* to this Monitoring Report.<br><br>The actual average daily operating temperature in the AOR is within the permitted range for all days covered by this monitoring period. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **324-TT-4-106A/C**<br>Type: Temperature transmitter<br>Accuracy class: ± 0.15% of span<br>Serial number: 966596 / 966598<br>Calibration frequency: 48 months<br>Date of last calibration: 29/01/2009<br>Validity: 28/01/2013 |
| Measuring/ Reading/ | Recording: Continuously |

| | |
|---|---|
| Recording frequency: | |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*. |

| **Data / Parameter:** | **P_g,IV** |
|---|---|
| Data unit: | Barg |
| Description: | Actual operating pressure ammonia oxidation reactor Hu-Chems IV |
| Measured /Calculated /Default: | Measured |
| Source of data: | Pressure transmitter / Monitoring System (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **3.58 barg**<br><br>The pressure in the ammonia oxidation reactor (AOR) is monitored by a two pressure transmitters. The pressure in the AOR is collected and subsequently the Delta-V system automatically calculates and reports the average pressure.<br>An excel book containing daily average values and automatic checks, if daily average values are within the permitted range, is attached as *Annex 2* to this Monitoring Report.<br><br>The actual average daily operating pressure in the AOR is within the permitted range for all days covered by this monitoring period. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **324-PT-4-305A/B**<br>Type: Pressure transmitter<br>Accuracy class: ± 0.1% of span<br>Serial number: 0966518/ 0966519<br>Calibration frequency: 48 Months |

| | |
|---|---|
| | Date of last calibration: 29/01/2009<br>Validity: 28/01/2013 |
| Measuring/ Reading/ Recording frequency: | Recording: Continuously |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*. |

| **Data / Parameter:** | **G_sup,IV** |
|---|---|
| Data unit: | - |
| Description: | Supplier of the ammonia oxidation catalyst Hu-Chems IV |
| Measured /Calculated /Default: | - |
| Source of data: | Supplier according to commercial invoice |
| Value(s) of monitored parameter: | **Johnson Matthey**<br><br>The supplier of the ammonia oxidation catalyst is the same as prior to the start of the project activity (G_sup,hist,IV) |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Every gauze change<br><br>Latest gauze changes, relevant to the monitoring period:<br>21/10/2009<br>04/05/2010 |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **G_com,IV** |
|---|---|
| Data unit: | % |
| Description: | Composition of the ammonia oxidation catalyst Hu-Chems IV |
| Measured /Calculated /Default: | - |
| Source of data: | Composition according to catalyst supplier information |
| Value(s) of monitored parameter: | **95% Pt**<br>**5% Rh**<br><br>The composition of the ammonia oxidation catalyst is the same kind of catalyst composition already in use prior to the start of the project activity. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Every gauze change<br><br>Latest gauze changes, relevant to the monitoring period:<br>21/10/2009<br>04/05/2010 |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **SE_N2O,IV** |
|---|---|
| Data 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 system (Delta V) / Production Reports<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **0.006 $tN_2O/tHNO_3$** |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |

| | |
|---|---|
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | - |
| Measuring/ Reading/ Recording frequency: | Recording: Yearly / Periodically |
| Calculation method (if applicable): | Calculated according to formulae given in PDD |
| QA/QC procedures applied: | - |

| **Data / Parameter:** | **A_OR,d,IV** |
|---|---|
| Data unit: | $tNH_3/d$ |
| Description: | Actual ammonia flow rate to the ammonia oxidation reactor Hu-Chems IV |
| Measured /Calculated /Default: | Measured |
| Source of data: | Flow meter / Monitoring system (Delta V)<br><br>Please refer also to *Section C – 1 (Information Flow)* of this Monitoring Report. |
| Value(s) of monitored parameter: | **342.44 $tNH_3/d$**<br><br>An excel book containing daily values and automatic checks, if daily values are within the permitted range, is attached as *Annex 2* to this Monitoring Report.<br><br>The actual daily ammonia flow rate to the AOR is within the permitted range for all days covered by this monitoring period. |
| Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations) | Baseline emission calculations |
| Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity) | **324-FT-4-5020**<br>Type: Coriolis flowmeter<br>Accuracy class: : ± 0.35% of span<br>Serial number: 14137655<br>Calibration frequency: 60 Months<br>Date of last calibration: 05/06/2009<br>Validity: 04/06/2014 |
| Measuring/ Reading/ Recording frequency: | Recording: continuously |
| Calculation method (if applicable): | - |
| QA/QC procedures applied: | 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).<br><br>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*.<br><br>Plausibility of ammonia input data is regularly checked by nitrogen balance. During the actual monitoring period, the conversion rate of ammonia nitrogen to nitric acid is within a plausible range. |

## SECTION E. Emission reductions calculation

### E.1. Baseline emissions calculation

>>

It has been checked that there are no Korean regulations in place that would limit the quantity of $N_2O$ that can be taken into account for the calculation of baseline emissions. Baseline emissions of the project activity are determined based on the quantity of $N_2O$ emitted in the baseline scenario, taking national regulations, production levels and operating conditions into consideration. The quantity of $N_2O$ is determined based on the measurements of the $N_2O$ at the inlet of the EnviNOx®-Systems.

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

e.g.

BE_y,II = BE_N2O,II x GWP_N2O **(27)**

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,II | Baseline emissions of $N_2O$ in year y at Hu-Chems II ($tN_2O$) |
| BE_N2O,III | Baseline emissions of $N_2O$ in year y at Hu-Chems III ($tN_2O$) |
| BE_N2O,IV | Baseline emissions of $N_2O$ in year y at Hu-Chems IV ($tN_2O$) |

BE_y,II = BE_N2O,y,II x GWP_N2O = [284.87 tN2O x 310 tCO2e / tN2O]

= $\sum_i^n F\_TG,i,II$ x CI_N2O,i,II x M_i,II x GWP_N2O =

= **88,310 $tCO_2e$**

BE_y,III = BE_N2O,y,III x GWP_N2O = [317.21 tN2O x 310 tCO2e / tN2O]

= $\sum_i^n F\_TG,i,III$ x CI_N2O,i,III x M_i,III x GWP_N2O =

= **98,335 tCO2e**

BE_y,IV = BE_N2O,y,IV x GWP_N2O = [627.40 tN2O x 310 tCO2e / tN2O]

= $\sum_i^n F\_TG,i,IV$ x CI_N2O,i,IV x M_i,IV x GWP_N2O =

= **194,494 tCO2e**

BE_y = BE_y,II + BE_y,III + BE_y,IV = [88,310 tCO2e + 98,335 tCO2e + 194,494 tCO2e]

= **381,139 tCO2e**

Excel spreadsheets including a comprehensive calculation of baseline emissions and traceable implementation of formulae are attached in Annex 2 to this Monitoring Report.

## E.2. Project emissions calculation

>>

The emissions due to the project activity are composed of (a) the emissions of not destroyed $N_2O$ and (b) emissions from the operation of the EnviNOx® systems at Hu-Chems II and III.

$N_2O$ emissions not destroyed by the project activity are calculated based on the continuous measurement of the $N_2O$ concentration in the tail gas of the EnviNOx® systems and the volume flow rates of the tail gas streams. The emissions related to the operation of the $N_2O$ destruction facility are given by on-site emissions due to the hydrocarbons used as input to the EnviNOx® systems (Hydrocarbons are used in plant Hu-Chems II and Hu-Chems III only. No hydrocarbons are used in plant Hu-Chems IV).

PE_y = PE_y,II + PE_y,III + PE_y,IV **(28)**

e.g.
PE_y,II = PE_ND,y,II + PE_DF,y,II **(29)**

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 from the operation of the destruction facility in year y Hu-Chems II ($tCO_2e$) |
| PE_DF,y,III | Project emissions from the operation of the destruction facility in year y Hu-Chems III ($tCO_2e$) |
| PE_DF,y,IV | Project emissions from the operation of the destruction facility in year y Hu-Chems IV ($tCO_2e$) |

PE_y,II = PE_ND,y,II + PE_DF,y,II = [2,325 tCO2e + 226 tCO2e]
= PE_N2O,y,II x GWP_N2O + PE_HC,y,II =
= $\sum_i^n F\_TG,i,II$ x CO_N2O,i,II x M_i,II x GWP_N2O + HCE_C,y,II =
= $\sum_i^n F\_TG,i,II$ x CO_N2O,i,II x M_i,II x GWP_N2O +
ρ_HC,II x Q_HC,y,II x EF_HC,II x OXID_HC,II/100 =
**= 2,551 tCO2e**

PE_y,III = PE_ND,y,III + PE_DF,y,III = [1,830 tCO2e + 274 tCO2e]
= PE_N2O,y,III x GWP_N2O + PE_HC,y,III =
= $\sum_i^n F\_TG,i,III$ x CO_N2O,i,III x M_i,III x GWP_N2O + HCE_C,y,III =

= $\sum_i^n F\_TG,i,III$ x CO_N2O,i,III x M_i,III x GWP_N2O +

ρ_HC,III x Q_HC,y,III x EF_HC,III x OXID_HC,III/100 =

= **2,104 $tCO_2e$**

PE_y,IV = PE_ND,y,IV + PE_DF,y,IV = [4,578 tCO2e + 0 tCO2e]

= PE_N2O,y,IV x GWP_N2O =

= $\sum_i^n F\_TG,i,IV$ x CO_N2O,i,IV x M_i,IV x GWP_N2O =

= **4,578 $tCO_2e$**

PE_y = PE_y,II + PE_y,III + PE_y,IV = [2,551 tCO2e + 2,104 tCO2e + 4,578 tCO2e]

= **9,233 $tCO_2e$**

Excel spreadsheets including a comprehensive calculation of project emissions and traceable implementation of formulae are attached in Annex 2 to this Monitoring Report.

## E.3. Leakage calculation

>>

As described the project activity does not result in any relevant leakage emission, therefore:

LE_y = 0 . **(30)**

## E.4. Emission reductions calculation / table

>>

The total emission reduction achieved by this project activity during the monitoring period is therefore:

ER_y = BE_y – PE_y – LE_y . **(31)**

where:

ER_y Emissions reductions of the project activity during the year y (tCO2e)
BE_y Baseline emissions during the year y (tCO2e)
PE_y Project emissions during the year y (tCO2e)
LE_y Leakage emissions in year y (tCO2e)

ER_y = BE_y – PE_y – LE_y

= 381,139 tCO2e – 9,233 tCO2e – 0 =

= **371,906 tCO2e**

| | |
|---|---|
| Total baseline emissions: | 381,139 tCO2e |
| Total project emissions: | 9,233 tCO2e |
| Total leakage: | 0 tCO2e |
| Total emission reductions: | 371,906 tCO2e |

*Plausibility Check*

Calculation of Baseline Emissions (QI_N2O) and of Project Emissions (PE_N2O) is done on a continuous basis. In order to assess the automatic calculation of these parameters in the DeltaV system, a plausibility check was performed. For that purpose, the calculation of Project and Baseline Emission Parameters has been conducted manually, based on daily average (concentrations) and total values (Flows) and using the same formulas implemented in the DeltaV system. The result clearly shows plausible data with only slight variations (all plants <0.02%) in the Emission Reduction calculation, compared to the applied calculation based on continuous values.

Applied calculations of relevant parameters (PE_N2O, QI_N2O) on a continuous basis guarantee a highly representative and accurate (almost real time) approach. The applied approach is in full compliance with methodology AM0028 Version 1 and respective, registered PDD. Traceable plausibility check is to prove correct and transparent application of formulas and clearly shows plausible data.

Excel spreadsheets including a comprehensive calculation of emission reductions traceable implementation of formulae and plausibility checks are attached in Annex 2 to this Monitoring Report.

## E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

>>

| Item | Values applied in ex-ante calculation of the registered CDM-PDD | Actual values reached during the monitoring period |
|---|---|---|
| **Emission reductions ($tCO_2e$)** | **Hu-Chems II: 82,124<br>Hu-Chems III: 82,124<br>Hu-Chems IV:154,983<br>Total: 319,231** | **Hu-Chems II: 85,759<br>Hu-Chems III: 96,231<br>Hu-Chems IV: 189,916<br>Total: 371,906** |

Reason for the increase in actual emission reductions achieved during the current monitoring period compared to ex-ante calculation of the registered CDM-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 the 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) | 329,397 tCO2e |
| Corresponding PDD estimation (over 91 days) | 82,124 tCO2e |
| Actual calculation of emission reduction in monitoring period (over 91 days) | 85,759 tCO2e |

The excess of the actual emission reduction during the monitoring period compared to the corresponding ex-ante estimation according to the PDD in nitric acid plant II 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 [97.37%];
- Due to the absence of actual values, an inlet concentration of [3.5E-06 $tN_2O$ / $Nm^3$] for baseline emission estimation in the PDD was used. Actual concentrations measured reach an average level of [3.84E-06 $tN_2O$ / $Nm^3$] and therefore lead to higher baseline emissions;

It should be noted that the ex-ante estimation of emissions reductions in the PDD was generally based on conservative assumptions.

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) | 329,397 tCO2e |
| Corresponding PDD estimation (over 91 days) | 82,124 tCO2e |
| Actual calculation of emission reduction in monitoring period (over 91 days) | 96,231 tCO2e |

The excess of the actual emission reduction during the monitoring period compared to the corresponding ex-ante estimation according to the PDD in nitric acid plant II 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 [98.14%];
- Due to the absence of actual values, an inlet concentration of [3.5E-06 $tN_2O$ / $Nm^3$] for baseline emission estimation in the PDD was used. Actual concentrations measured reach an average level of [3.65E-06 $tN_2O$ / $Nm^3$] and therefore lead to higher baseline emissions;

It should be noted that the ex-ante estimation of emissions reductions in the PDD was generally based on conservative assumptions.

**Table 1:** 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) | 621,634 tCO2e |
| Corresponding PDD estimation (over 91 days) | 154,983 tCO2e |
| Actual calculation of emission reduction in monitoring period (over 91 days) | 189,916 tCO2e |

The excess of the actual emission reduction during the monitoring period compared to the corresponding ex-ante estimation according to the PDD in nitric acid plant IV 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 [97.65%];
- Due to the absence of actual values, an inlet concentration of [1.7E-06 $tN_2O$ / $Nm^3$] for baseline emission estimation in the PDD was used. Actual concentrations measured reach an average level of [1.9E-06 $tN_2O$ / $Nm^3$] 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 [156,672 $Nm^3$ / h] and therefore contribute to a higher emission reduction than estimated.

It should be noted that the ex-ante estimation of emissions reductions in the PDD was generally based on conservative assumptions.

## ANNEX 1

**Social Fund**

As described in the PDD a social fund was established by the project developer and the project operator. This fund will contribute to the social benefit of the people living in the area of the project activity by financing projects and social activities. The contribution to the Social Fund in 2009 was about 583,000,000 Korean WON, equivalent to about 320,000 Euro. Projects and Organizations supported by the CDM Social Fund are the Yeodo Academy, the Endowment of In-Company welfare fund and the Sang am village fund. The Yeodo Academy intends to improve the basic elementary and secondary education and the objective of the Welfare Fund is to contribute to working employees' life stabilization and welfare improvement.

- 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)

## ANNEX 2

Excel books containing calculations of baseline emissions, project emissions and emission reductions as well as daily values of operating parameters (including automatic checks) of the nitric acid plants are attached as separate files:

HUC_II_MP13_UNFCCC
HUC_III_MP13_UNFCCC
HUC_IV_MP13_UNFCCC
HUC_OVERALL_MP13_UNFCCC

- - - - -

**History of the document**

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|---|---|---|
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