MONITORING REPORT FORM (CDM-MR)
Version 01 - in effect as of: 28/09/2010

CONTENTS

MONITORING REPORT
Version 1, Date 26/01/2011
Title: CATALYTIC N_2O ABATEMENT PROJECT IN THE TAIL GAS OF THE NITRIC ACID PLANT OF THE HANWHA CORPORATION (HWC) IN ULSAN, REPUBLIC OF KOREA

Reference number: 0922

The 4th Monitoring period : 01/01/2010-31/12/2010

SECTION A. General description of the project activity

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

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1. Purpose of the project activity and the measures taken to reduce greenhouse gas emissions :
Hanwha Corporation owns Nitric Acid Plant in Ulsan City, Republic of Korea and produces nitric acid and based on which Hanwha Corporation further produces explosives mainly. From the plant, Nitrous Oxide (N_2O), which is an undesired by-product of the nitric acid production process, is released into the atmosphere.
Hanwha Corporation has one production line. The aim of the project activity is to reduce N_2O emissions by installation of DeN_2O Unit before the Stack, which is called Tertiary Catalyst System or Tail Gas System.

2. Brief description of the installed technology and equipments :
For the N_2O abatement project, Tertiary Catalyst System has been installed in the Nitric Acid Production Line, which consists of the catalyst, supplied by N.E.Chemcat Corporation, Japan as well as the reactor, supplied by Sumitomo Metal Mining Engineering Corporation, Japan.
In order to monitor the N_2O reduction, the Automated Measuring Systems (AMS), including non-dispersion infrared absorption analyzer (NDIR) was installed, which is applicable to European standards and norms (EN 14181) or equivalent standards.

3. Relevant dates for the project activity :
Registration by UNFCCC : May 3, 2007
Registration Number : 0922
Start of destruction of N_2O : June, 27, 2007

4. Total emission reductions achieved in this monitoring period (01/01/2010 – 31/12/2010) :
241,718 ton:

A.2. Project Participants

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Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Korea (host)	**Hanwha Corporation (HWC)** [owner and operator of the nitric acid plant]	No
	Mitsubishi Corporation (Korea) Ltd. [developer and co-financer of this CDM project]	No

Japan	**Mitsubishi Corporation** [developer and co-financer of this CDM project]	No

A.3. Location of the project activity:

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Hanwha's Nitric Acid Plant is located at 753-22 Onsan eup, Ulju gun, Ulsan city, 689-892, Republic of Korea. It is about 400km from Seoul city, the capital of the country. The physical location of the plant is 35.2043, 129.1223 (Latitude 35.2043 north and Longitude +129.1223 east).

A.4. Technical description of the project

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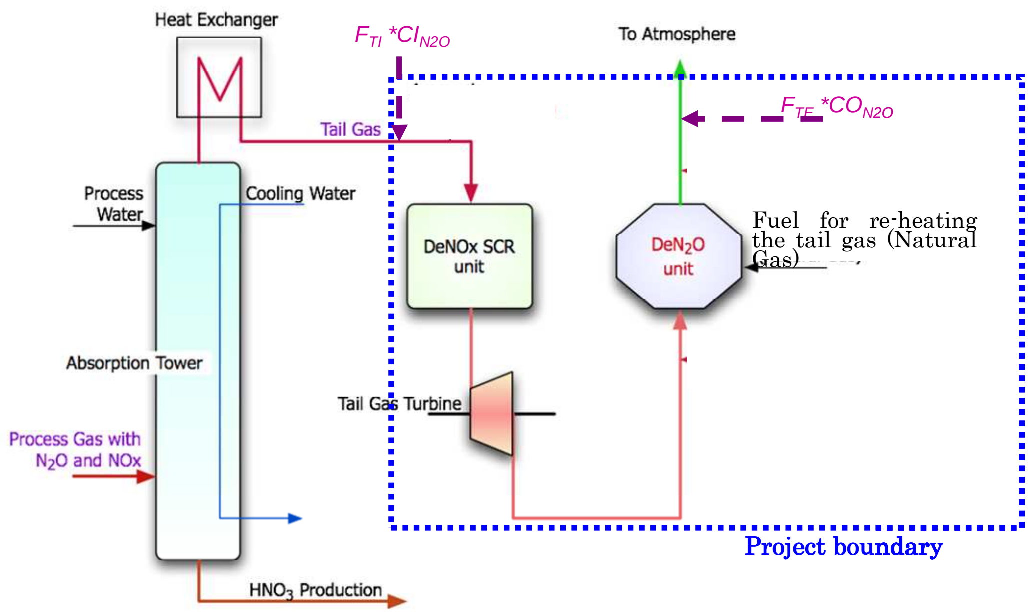
The N_2O abatement technology is to introduce a tertiary catalyst in the nitric acid production process, just before the stack. N_2O is decomposed by a chemical catalytic reaction as following through the process.

$$N_2O \rightarrow N_2 + (1/2)\, O_2$$

Fig. 1 Configuration of the N_2O abatement system



For the N_2O abatement project, the tertiary catalyst of N.E.Chemcat Corporation, Japan was selected, as well as the reactor of Sumitomo Metal Mining Engineering Corporation, Japan as the De N_2O Unit. .

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

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AM0028 version 3 : "Catalytic N_2O destruction in the tail gas of Nitric Acid or Caprolactam production plants --- version 3".

A.6. Registration date of the project activity:

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Registration date: May 3, 2007

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

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27 June 2007 – 26 June 2014 (renewable).
7 year crediting period with twice renewal (total 21 years) was selected for the project activity.
It was changed from 01 July 2007 – 30 June 2014 and such change was approved by UNFCCC on January 29, 2008.

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

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Mr. Kazuki Miura, Mitsubishi Corporation (Project Participant)
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ml.en-x@mitsubishicorp.com
Tel : +81-3-3210-7574

SECTION B. Implementation of the project activity

B.1. Implementation status of the project activity

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1. The starting date of operation of the project activity :
   June 27, 2007.

2. The information regarding the actual operation of the project activity during this monitoring period, including information on special events, for example overhaul times, downtimes of equipment, exchange of equipment, etc :
   Please see the "Daily Events" mentioned in Annex 2.

3. A brief description of: (i) events or situations that occurred during the monitoring period, which may impact the applicability of the methodology, and (ii) how the issues resulting from these events or situations are being addressed :
   N/A

B.2. Revision of the monitoring plan

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Request for revision for the changing of measurement range of outlet of N_2O concentration was applied to UNFCCC, which was approved on September 7, 2010.

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

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No request for deviation was applied.

B.4. Notification or request of approval of changes

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No notification or request of approval of changes was applied.

SECTION C. Description of the monitoring system

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Please provide a description of the monitoring system. This section may include data collection procedures (information flow including data generation, aggregation, recording, calculation and reporting), organization structure, roles and responsibilities of personnel and emergency procedures for the monitoring system.
This shall include line diagrams showing all relevant monitoring points.

1. Monitoring plan and methodology

The approved monitoring methodology AM0028 version 3 “Catalytic N_2O destruction in the tail gas of Nitric Acid or Caprolactam Production Plants” was applied to this project activity. This approved monitoring methodology is applicable to the project activities that abate N_2O emissions either by catalytic decomposition or catalytic reduction of N_2O in the tail gas of nitric acid plants (i.e. tertiary destruction). The present project activity satisfies applicability conditions.

2. Data collection procedure

Please see the figure below for position of monitoring parameters for the project. Respective data from each monitoring points are generated, aggregated, recorded, calculated and reported as follows.
Data collection flow of the monitoring system is as per the chart below :

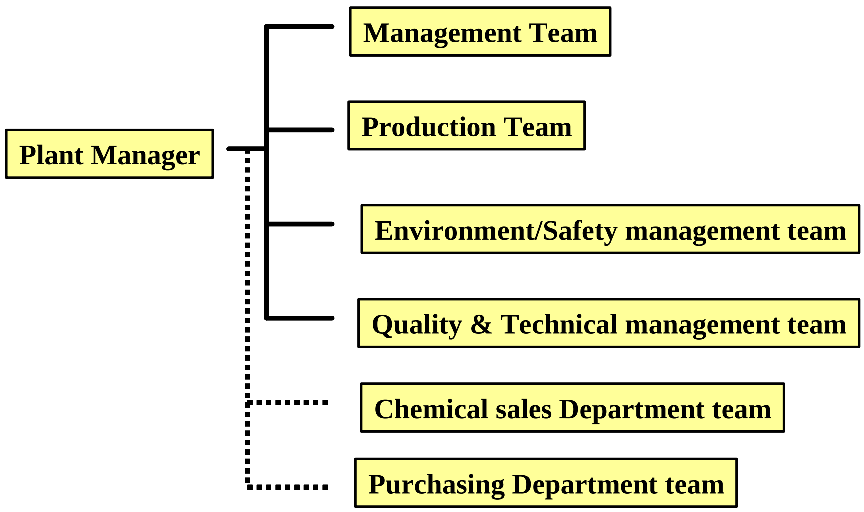
Para-meter	Data description	Data generation	Measured by		Aggregation/ Recording		Calcu-lation		Repo rting
$CI_{N2O,i}$	N2O concentration at destruction facility inlet.	Inlet of DeN2O	Non-dispersion infrared absorption analyzer		ABB data logging system		Excel spread sheet (Accor-ding to AM0028)		By Hanwha and Mitsubishi
$F_{TI,i}$	Volume flow rate at the inlet of the destruction facility		Multiple-point sampling tube type flow meter with D/P Transmitter, Absolute pressure transmitter and Resistance Temperature Detector						
$CO_{N2O,i}$	N2O concentration at destruction facility outlet.	Outlet of DeN2O	Non-dispersion infrared absorption analyzer						
$F_{TE,i}$	Volume flow rate at the exit of the destruction facility		Multiple-point sampling tube type flow meter with D/P Transmitter, Absolute pressure transmitter and Resistance Temperature Detector						
Q_{NG}	Hydrocarbon (Natural gas) input	DeN2O	Integral Orifice flow meter with temperature, pressure measuring unit for auto compensation	⇨		⇨		⇨	
Natural gas contents information			Ingredients label by the natural gas supplier		by handling				
$P_{product,y}$	Plant output of HNO3	Outlet of absorption tower	Magnetic flow meter with Resistance Temperature Detector		DCS system (distributed control system)				
$A_{OR,d}$	Actual ammonia flow rate to the ammonia oxidation reactor	Inlet of AOR	Orifice type flow meter with D/P Transmitter, Absolute pressure transmitter and Resistance Temperature Detector						
T_g	Actual operating temperature of the ammonia oxidation reactor	Inside AOR	Thermocouple (Type "R") with temperature transmitter						
P_g	Actual operating pressure of the ammonia oxidation reactor	Between air compressor/ NH3 air mixer	Pressure Transmitter						
$EI_{RCS,y}$	Additional electricity input for running DeN2O unit	DeN2O unit operating panel	Electricity accumulator (Wattmeter)		Hand writing				

3.Organization structure of Hanwha’s project team, including the role and responsibility of the personnel

Hanwha has been operating the nitric acid plants since the commissioning of the plant in 1992 and has sufficient and well-experienced staffs. Hanwha has been in production of the nitric acid for number of years and measurement of various production parameters including operation of analyzers which are managed by production team. The monitoring of the N_2O for the project is responsible by production team. The operation and maintenance of the N_2O monitoring system incorporates the ISO 9001-2000 standard procedures. The monitoring of the relevant data is done by the N_2O monitoring system and recorded onto the electric media.

Production team is appointed and responsible for the operation of the N_2O monitoring system. Production team follows the monitoring plan and reports the data on regular intervals to management team and plant manager in ascending order.

An illustrative scheme of the operational and management structure is as follows:



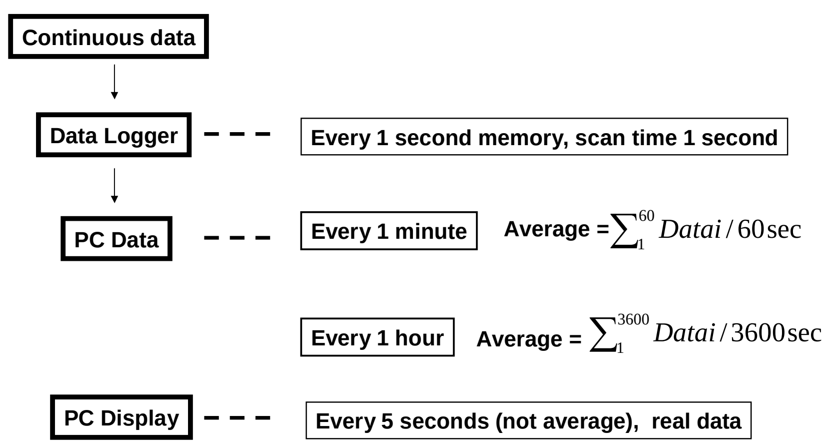
4. Emergency procedures for the monitoring system

In case of emergency or any deviation in the monitoring data is found, production team engineer shall study the operating parameters of the nitric acid plant to identify the reason for the deviation and take remedial measures. If there is no change in the operating parameter of nitric acid plant, the monitoring system shall be examined. Once the default is identified, quality & technical management team and environment & safety management team shall introduce a correction to the default. Production team engineer shall report such irregular event to plant manager.

For others concerning good monitoring practice and performance characteristics including such as EN14181 or equivalent standards available in the Republic of Korea specified in AM0028 version03.

5. Monitoring and calculation details of N2O concentration & tail gas measurement

Following method is applied :



6. Calibration and maintenance

All measuring and analytical instruments are calibrated as defined in the approved methodology AM0028 version3. Calibration procedures have been incorporated in Hanwha Corporation's quality management system and procedures.

The measurement equipments are calibrated on regular intervals as recommended by the manufacturers. Additionally, selected staffs from Hanwha Corporation participate in initial training and are trained to operate measurement system.

For other concerning good monitoring practice and performance characteristics including such as EN14181 or equivalent standards available in Republic of Korea specified in AM0028 version 3, which is mentioned in Annex 4 of concerned PDD.

Information of calibration of each equipment is as below :

Instrument Overview: Hanwha	
Instrument	**TAG Number**
Destruction Facility Inlet Analyzer	10-AT-061(A1061)
Destruction Facility Outlet Analyzer	10-AT-062(A1062)
Inlet Tail Gas Flow	10-FT-561(F1561)
Outlet Tail Gas Flow	10-FT-562(F1562)
LNG Flow to Destruction Facility	10-FX-563(F1563)
Ammonia Flow to AOR	10-PT-502(P1502)
Pressure in AOR	10-PT-304(P1304)
Temperature in AOR	10-TT-115(T1115)
HNO3(Nitric Acid) Flow	10-FT-512(F1512)

More information of calibration of each instrument is available in Annex-3

SECTION D. Data and parameters

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

Data / Parameter:	GWP_{N2O}
Data unit:	tCO_2e/tN_2O
Description:	Global warming potential of the nitric oxide
Source of data used:	IPCC, The Second Assessment Report
Value(s):	310, as specified in the methodology
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations)	Baseline, Project
Additional comment:	N/A

Data / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential of the methane
Source of data used:	IPCC, The Second Assessment Report
Value(s):	21, as specified in the methodology
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations)	Project
Additional comment:	N/A

Data / Parameter:	Reg_{Nox}
Data unit:	tNO_X/m^3
Description:	National regulation on NO_X emissions to be checked and applied
Source of data used:	National environmental legislation in the Republic of Korea
Value(s):	$2.92 * 10^{-7}$ (tNO_X/m^3) Clean Air Conservation Act of the Republic of Korea Currently, NO_X regulation requires limiting the emissions below 200 ppmv.
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations)	Baseline
Additional comment:	In Hanwha Onsan plant, NO/NO_2 ratio of the tail gas before NH_3 SCR installation was 2.1 : 1. But after NH_3 SCR installation, NO/NO_2 average ratio has been 4.9 : 1. Therefore, NO_X 200ppmv equals to NO 166ppmv plus NO_2 34ppmv. NO 166ppmv is $2.22 * 10^{-7}$ $tonNO/m^3$ and NO_2 34ppmv is $0.70 *10^{-7}$ $tonNO_2/m^3$. And the Sum of NO and NO_2 equals to $2.92 *10^{-7}$ $tonNOx/m^3$.

Data / Parameter:	$P_{product,max}$
Data unit:	$tHNO_3/yr$
Description:	Design capacity of nitric acid production of the targeted line
Source of data used:	Manufacturer's specification
Value(s)	107,100 $tHNO_3/yr$
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations	Baseline
Additional comment:	It is in accordance with the methodology. Based on the past record, Hanwha's maximum daily production is 306ton/day, which was recorded in 1992 and maximum operating days is 350day, which was recorded in 2002. Therefore, yearly maximum is as follows; 306 [HNO_3/day]*350[day/yr] The amount of emission reductions is capped by $P_{product,max}$.

Data / Parameter:	$T_{g,hist}$
Data unit:	°C
Description:	Historical operating temperature range of the ammonia oxidation reactor
Source of data used:	Production reports Daily average temperature from hourly snapshot data.
Value(s):	867.4–905.2 °C As specified in the methodology, the permitted range of operating temperatures is set based on historical data (Jan.2000-Nov.2003 and Jan.2005-Oct.2006). The lower limit is 2.5% lower value of these available data and the upper limit is 2.5% upper value of them. If the actual average daily operating temperature in the ammonia oxidation reactor (T_g) is outside this "permitted range", the baseline N_2O emissions for that period are capped at 4.5kgN_2O/tonne of nitric acid conservatively applying the IPCC default value.
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations	Baseline
Additional comment:	N/A

Data / Parameter:	$P_{g,hist}$

Data unit:	Pa
Description:	Historical operating pressure range of the ammonia oxidation reactor
Source of data used:	Production reports Daily average pressure from hourly snapshot data.
Value(s):	8.035-9.820 $*10^5$ Pa abs (7.022–8.806 $*10^5$ Pa gauge) Specified in the methodology. The permitted range of operating pressures is set based on historical data (Jan.2000-Nov.2003 and Jan.2005-Oct.2006). Operating pressure is measured at two points. One is between air compressor and NH_3 air mixer (since Jan.2000), and another is between NH_3 air mixer and NH_3 air filter (since Jan.2005). The permitted range is determined based on data measured at the former which the number of acquisition records is larger. The lower limit is 2.5% lower value of these available data and the upper limit is 2.5% upper value of them. If the actual average daily operating pressure in the ammonia oxidation reactor (P_g) is outside this "permitted range", the baseline N_2O emissions for that period are capped at 4.5kgN_2O/tonne of nitric acid conservatively applying the IPCC default value.
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations	Baseline
Additonal comment:	N/A

Data / Parameter:	$G_{sup,hist}$
Data unit:	-
Description:	Historical supplier's information of the ammonia oxidization catalyst
Source of data used:	Ammonia oxidization catalyst supplier
Value(s):	Name of the supplier: Johnson Matthey
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations	Baseline
Additonal comment:	N/A

Data / Parameter:	$G_{com,hist}$
Data unit:	%
Description:	Historical composition of the ammonia oxidization catalyst
Source of data used:	Ammonia oxidization catalyst supplier
Value(s):	Pt: 95%, Rh: 5%
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations	Baseline
Additional comment:	N/A

Data / Parameter:	SE_{N2O}
Data unit:	kgN_2O/tHNO_3
Description:	N_2O emission rate per ton of nitric acid
Source of data used:	Pre-publication Draft 2006 IPCC Guidelines accepted by the 21st Session of the IPCC
Value(s):	4.5 kgN_2O/tHNO_3 Specified in the methodology. This value is the conservative IPCC default value of Nitric Acid Plants which is based on the default emission factor for low-pressure plants. (5kgN_2O/tonne of nitric acid, accounting for 10% uncertainty factor)

Indicate what the data are used for (Baseline/Project/ Leakage emission calculations	Baseline
Additional comment:	N/A

Data / Parameter:	$A_{OR,hist}$
Data unit:	tNH_3/day
Description:	Maximum of historical ammonia flow rate of the ammonia oxidization reactor
Source of data used:	Production reports
Value(s):	88 tNH_3/day Specified in the methodology. This is a maximum value of daily ammonia flow rates based on historical data (Jan.2000-Nov.2003 and Jan.2005-Oct.2006). If the daily ammonia input to the oxidation reactor ($A_{OR,d}$) exceeds maximum historical ammonia input to oxidation reactor ($A_{OR,hist}$), the baseline N_2O emissions for that period are capped at 4.5kgN_2O/tonne of nitric acid conservatively applying the IPCC default value.
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations	Baseline
Additional comment:	N/A

Data / Parameter:	M_i
Data unit:	Hour
Description:	Measuring interval
Source of data used:	Defined in the technical specifications of data logging system
Value(s):	1 hour QA/QC procedures will be applied by regular maintenance of the data logging system.
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations	Baseline, Project
Additional comment:	N/A

Data / Parameter:	$OXID_{NMHC}$
Data unit:	%
Description:	Oxidization factor of the hydrocarbon (Non-methane part of the natural gas)
Source of data	AM0028 version03
Value applied	100% Specified in the methodology. For this project, fraction of methane not converted will not be measured due to unreasonable costs, so 100% is applied for this parameter based on AM0028 version03. It is very minor contribution
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations	Project
Additional comment:	N/A

Data / Parameter:	$OXID_{CH4}$
Data unit:	%
Description:	Oxidization factor of methane (Methane part of the natural gas)
Source of data used:	AM0028 version03
Value(s):	0% Specified in the methodology. For this project, fraction of methane not converted will not be measured due

	to unreasonable costs, so 0% is applied for this parameter based on AM0028 version03.
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations	Project
Additional comment:	N/A

Data / Parameter:	EF_{RCS}
Data unit:	tCO_2e/MWh
Description:	Emission factor of the electricity for running the DeN_2O unit
Source of data used:	2000~2004 Statistics of electric power in Korea (The Korea Electrical Power Corporation (KEPCO), http://www.kepco.co.kr)
Value(s):	0.62 (tCO_2e/MWh) for national power gird in the Republic of KEPCO. The emission factor is referring to baseline emissions factor described in PDD of "Youngduk Wind Park Project" which was already registered as CDM (http://cdm.unfccc.int/UserManagement/FileStorage/XH4MZ6TAOURT6745ZMBZEGWQH6QVUS). And it is calculated by combined margin (CM) based on data in 2000~2004 shown by source the yearly book of KEPCO 2001~2005. The value is calculated as ACM0002 option 1, ex-ante based. It is very minor contribution.
Indicate what the data are used for (Baseline/Project/ Leakage emission calculations	Project
Additional comment:	N/A

D.2. Data and parameters monitored

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Actual data monitored for each parameter are given below :

Data / Parameter:	$F_{TI,i}$
Data unit:	Nm^3
Description:	Volume flow rate at the inlet of the destruction facility
Measured/Calculated /Default	Measured
Source of data	Multiple-point sampling tube type flow meter with Resistance Temperature Detector and D/P Transmitter
Value(s) of monitored parameter	300,600,042 Nm^3 (total volume from 01/January/2010 to 31/Dec/2010, from the actual data) Refer to the spread sheet
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	● Type : Multiple-point sampling tube type flow meter (Maker/Model : Honeywell, STD924-E1H-000000-S2) with Resistance Temperature Detector (Maker/Model : WISE controls, R221+MTM) and Absolute Pressure Transmitter (Maker/Model : Honeywell, STG 944-E1G-00000-S1) ● Serial Number : Multiple-point sampling tube type flow meter : 0553 05121501009, 0712007030214004 (Instrument No. 10-FT-561) Resistance Temperature Detector : WS-7M425, WS-7M139 (Instrument No.10-TT-161) Absolute Pressure Transmitter : 0552 05121501007, 0712 07030214004

	(Instrument No. 10-PT-361) ● Accuracy class : According to the supplier's specification Multiple-point sampling tube type flow meter : ±0.075% ,of full scale Resistance Temperature Detector : ±0.3% ,of full scale Absolute Pressure Transmitter : ±0.065% ,of full scale ● Calibration frequency : Based on EN14181 and frequency is as below Multiple-point sampling tube type flow meter : 15 months Resistance Temperature Detector : 15 months Absolute Pressure Transmitter : 15 months ● Date of last calibration Multiple-point sampling tube type flow meter : August 9, 2010 Resistance Temperature Detector : August 9, 2010 Absolute Pressure Transmitter : August 9, 2010 ● Validity : Multiple-point sampling tube type flow meter : November 8, 2011 Resistance Temperature Detector : November 8, 2011 Absolute Pressure Transmitter : November 8, 2011 Based on EN14181, variability test and validity of the calibration function is annually crosschecked by AST ● Measuring point : At the tail gas duct before DeN_2O unit ● Measuring range : 0-60,000 Nm^3/hr
Measuring/Reading/ Recording frequency	● Measuring frequency : Continuously ● Reading frequency : Continuously ● Recording frequency : Continuously (Hourly average)
Calculation method (if applicable) :	N/A
QA/QC procedures applied:	Calibration frequency : refer to the above.. FTI Both parameters shall be cross-checked to ensure that no leak of N_2O is taking place. In case of discrepancy, conservative calculation of emission reduction shall be provided.

Data / Parameter:	$CI_{N2O,I}$
Data unit:	tN_2O/m^3
Description:	N_2O concentration at destruction facility inlet.
Measured/Calculated /Default	Measured
Source of data	Non-dispersion infrared absorption analyzer (NDIR)
Value(s) of monitored parameter	3.110638 E-06 tN_2O/Nm^3 (=1,589 ppmv*44/22.4) (average concentration from 01/January/2010 to 31/Dec/2010, from the actual data) Refer to the spread sheet
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	● Type : Non-dispersion infrared absorption analyzer. (Maker/Model: ABB/ AO2040/Uras26) ● Serial number : 3.346996.7 (Instrument No. AI-061) ● Accuracy class : ±0.02% of full scale, according to the supplier's specification ● Calibration frequency : every 10 days ● Date of last calibration : February 15, 2011 ● Validity : February 25, 2011 Based on EN14181, variability test and validity of the calibration function is annually crosschecked by AST

	• Measuring point : At the tail gas duct before DeN_2O unit • Measuring range : 0-3,000ppmv
Measuring/Reading/ Recording frequency	• Measuring frequency : Continuously • Reading frequency : Continuously • Recording frequency : Continuously (Hourly average)
Calculation method (if applicable) :	Concentration*44/22.4
QA/QC procedures applied:	ABB AO2040 Uras26 which is fitted with integral calibration check cell is used. Calibration is done manually and is recorded on the data logging system. The calibration is carried out weekly. Calibration is intended to be done by the plant operator with routine procedure for QAL-3 certification of the system. In case Non-dispersion infrared absorption analyzer is used, it shall be checked by gas chromatography periodically. QA/QC for the analyzer shall be subjected to the EN14181 or equivalent standards available in the Republic of Korea.

Data / Parameter:	$F_{TE,I}$
Data unit:	Nm^3
Description:	Volume flow rate at the exit of gas the destruction facility
Measured/Calculated /Default:	Measured
Source of data:	Multiple-point sampling tube type flow meter with Resistance Temperature Detector and D/P Transmitter
Value(s) of monitored parameter:	308,112,423 Nm^3 (total volume from 01/January/2010 to 31/Dec/2010, from the actual data) Refer to the spread sheet
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	• Type : Multiple-point sampling tube type flow meter (Maker/Model : Honeywell, STD924-W1H-00000-S2) with Resistance Temperature Detector (Maker/Model : WISE controls, R221+MTM) and Absolute Pressure Transmitter (Maker/Model : Honeywell, STG 944-E1G-000000-S1) • Serial Number : Multiple-point sampling tube type flow meter : 0553 05121501010, 0712 07030214002 (Instrument No. 10-FT-562) Resistance Temperature Detector : WS-7M423, WS-7M140 (Instrument No.10-TT-162) Absolute Pressure Transmitter : 9853 00002001004, 9853 00002001004 (Instrument No. 10-PT-362 • Accuracy class : (according to the supplier's specification) Multiple-point sampling tube type flow meter : ±0.075% ,of full scale Resistance Temperature Detector : ±0.3% ,of full scale Absolute Pressure Transmitter : ±0.065% ,of full scale • Calibration frequency : Based on EN14181 and frequency is as below Multiple-point sampling tube type flow meter: 15 months Resistance Temperature Detector : 15 months D/P Transmitter : 15 months • Date of last calibration Multiple-point sampling tube type flow meter : August 9, 2010 Resistance Temperature Detector : August 9, 2010 D/P Transmitter : August 9, 2010 • Validity : Multiple-point sampling tube type flow meter : November 8, 2011

	Resistance Temperature Detector : November 8, 2011 Absolute Pressure Transmitter : November 8, 2011 Based on EN14181, variability test and validity of the calibration function is annually crosschecked by AST ● Measuring point : At the tail gas duct after DeN_2O unit ● Measuring range : 0-60,000 Nm^3/hr
Measuring/Reading/ Recording frequency	● Measuring frequency : Continuously ● Reading frequency : Continuously ● Recording frequency : Continuously (Hourly average)
Calculation method (if applicable) :	N/A
QA/QC procedures applied:	Calibration frequency : refer to the above. FTI Both parameters shall be cross-checked to ensure that no leak of N_2O is taking place. In case of discrepancy, conservative calculation of emission reduction shall be provided.

Data / Parameter:	$CO_{N2O,i}$
Data unit:	tN_2O/Nm^3
Description:	N_2O concentration at destruction facility outlet.
Measured/Calculated /Default	Measured
Source of data	Non-dispersion infrared absorption analyzer (NDIR)
Value(s) of monitored parameter	3.778517 E-07 tN_2O/Nm^3 (=192 ppmv*44/22.4) (average concentration from 01/January/2010 to 31/Dec/2010, from the actual data) Refer to the spread sheet
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	● Type : Non-dispersion infrared absorption analyzer : Maker/Model: ABB/ AO2040/Uras26) ● Serial number : 3.346996.7 (Instrument No. 10-AI-062) ● Accuracy class : ±0.02% of full scale, according to the supplier's specification ● Calibration frequency : every 10 days ● Date of last calibration : February 15, 2011 Validity : February 25, 2011 Based on EN14181, variability test and validity of the calibration function is annually crosschecked by AST ● Measuring point : At the tail gas duct after DeN_2O unit ● Measuring range : 0-500ppmv Measuring range was changed from 0-300ppmv to 0-500ppmv on January 19, 2009 by Airtec during AST and it was duly mentioned in the AST report. Also, it was applied to UNFCCC as request for revision, which was approved on September 7, 2010.
Measuring/Reading/ Recording frequency	● Measuring frequency : Continuously ● Reading frequency : Continuously ● Recording frequency : Continuously(Hourly average)
Calculation method (if applicable) :	Concentration*44/22.4
QA/QC procedures applied:	ABB AO2040 Uras26 which is fitted with integral calibration check cell is used. Calibration is done manually and will be recorded on the data logging system. The calibration is carried out weekly. Calibration is intended to be done by the plant operator with routine procedure for QAL-3 certification of the system.

	In case Non-dispersion infrared absorption analyzer is used, it shall be checked by gas chromatography periodically. QA/QC for the analyzer shall be subjected to the EN14181 or equivalent standards available in the Republic of Korea.

Data / Parameter:	$P_{product,y}$
Data unit:	$tHNO_3$
Description:	Plant output of HNO_3.
Measured/Calculated /Default	Measured
Source of data	ERP (Enterprise Resource Planning) Report and magnetic flow meter
Value(s) of monitored parameter	95,275.96 $tHNO_3$ (total volume from 01/January/2010 to 31/Dec/2010, from the actual data) Refer to Annex-2, item-5 of the monitoring report and also the spread sheet
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	● Type : Magnetic flow meter(Maker/Model : YAMADAKE,/MGG14C-BB1A-XCXX-YABJ, Rosemount/Emerson/8705TPA020S1W0G3B3Q4) ● Serial number : R-98417-41-021, 0870138304 (Instrument No. 10-FT-512) ● Accuracy class : ±0.02% of full scale, according to the supplier's specification ● Calibration frequency : 15 months ● Date of last calibration : July 28, 2010 ● Validity : October 27, 2011 ● Measuring point : At the product line before storage tanks ● Measuring range : 0-30 m^3/hr
Measuring/Reading/ Recording frequency	● Measuring frequency : Continuously ● Reading frequency : Continuously ● Recording frequency : Continuously(Hourly average)
Calculation method (if applicable) :	Refer to Annex-2, item 5. This parameter is calculated as follows : $P_{product,y} = QHNO_3 * CHNO_3 / 100 * DHNO_3$ Where: $QHNO_3$: Total flow rate of produced nitric acid monitored (not converted to 100% base) in a year y (m^3) $CHNO_3$: Average mass concentration of produced nitric acid (not pure) (%) $DHNO_3$: Average density of produced nitric acid (not pure) (t/ m^3)
QA/QC procedures applied:	Cross – check of production, marketing and stock change data. Measurement devices such as weighbridge can be subjected to QA /QC scheme consistent with the procedures in T_g, P_g, $F_{TI,i}$, $F_{TE,i}$, $C_{ON2O,i}$, $CI_{N2O,i}$, M_i, $Q_{HC,y}$ and SE_{N2O}, with respect to equipment certification, installation and performance.

Data / Parameter:	T_g
Data unit:	°C
Description:	Actual operating temperature of the ammonia oxidation reactor
Measured/Calculated /Default	Measured
Source of data	Thermo-couple (Type "R")
Value(s) of monitored parameter	Maximum temperature : 905.38 °C (July 21,2010) Minimum temperature : 870.41 °C (March 28, 2010) ** Permitted range : 867.4-905.2 °C Refer to the spread sheet and default data
Indicate what the data are used for (Baseline/Project/Leakage	Baseline

emission calculations)	
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	● Type : Thermocouple (Maker/Model : YOKOGAWA/YTA 110) ● Serial number : C2D807670435, C2E104013502 (Instrument No. 10-TT-115) ● Accuracy class : ±1.5 deg C of full scale , according to the supplier's specification ● Calibration frequency : 15 months Date of last calibration : August 9, 2010 ● Validity : November 8, 2011 ● Measuring point : At the oxidation reactor ● Measuring range : 0-1,200°C
Measuring/Reading/ Recording frequency	● Measuring frequency : Continuously ● Reading frequency : Continuously ● Recording frequency : Continuously (Hourly average)
Calculation method (if applicable)	If the average daily operating temperature in the ammonia oxidation reactor (T_g) is outside the permitted range ($T_{g,hist}$), the baseline N_2O emission for that period are capped at 4.5kgN_2O/tonne of nitric acid conservatively applying the IPCC default value.
QA/QC procedures applied:	Hanwha's maintenance and testing regime including calibration based on the vendor requirement.

Data / Parameter:	P_g
Data unit:	Pa
Description:	Actual operating pressure ammonia of the oxidation reactor
Measured/Calculated /Default	Measured
Source of data	Pressure transmitter
Value(s) of monitored parameter	Maximum pressure : 897,714 Pa.g (Nov 26, 2010) = (8.97714*10^5 Pa gauge) Minimum pressure : 705,535 Pa.g (Mar 1, 2010) = (7.05535*10^5 Pa gauge) ** Permitted range : 8.035-9.820 *10^5 Pa abs (7.022–8.806 *10^5 Pa gauge) Refer to the spread sheet and default data
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	● Type : Pressure transmitter (Maker/Model : Honeywell/STG 944-E1G-00000-S1) ● Serial number : 055305121501006, 072907062904012 (Instrument No. 10-PT-304) ● Accuracy class : ±0.065% of full scale, according to the supplier's specification ● Calibration frequency : 15 months ● Date of last calibration : August 9, 2010 ● Validity : November 8, 2011 ● Measuring point : two points, one is between air compressor and NH_3 air mixer (since Jan.2000) and another is between NH_3 air mixer and NH_3 air filter (since Jan.2005). $P_{g,hist}$ is based on data measured at the former which the number of acquisition record is larger. ● Measuring range : 0-16kgf/cm^2gauge
Measuring/Reading/ Recording frequency	● Measuring frequency : Continuously ● Reading frequency : Continuously ● Recording frequency : Continuously (Hourly average)
Calculation method (if applicable)	If the average daily operating pressure in the ammonia oxidation reactor (P_g) is outside the permitted range ($P_{g,hist}$), the baseline N_2O emission for that period are capped at 4.5kgN_2O/tonne of nitric acid conservatively applying the IPCC default value.

QA/QC procedures to be applied:	Hanwha's maintenance and testing regime including calibration based on the vendor requirement.

Data / Parameter:	G_{sup}
Data unit:	-
Description:	Supplier's information of the ammonia oxidization catalyst
Measured/Calculated /Default	Measured
Source of data	Ammonia oxidization catalyst supplier
Value(s) of monitored parameter	Name of supplier: Johnson Matthey
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	During the monitoring period
Calculation method (if applicable)	N/A
QA/QC procedures applied:	Not needed

Data / Parameter:	G_{com}
Data unit:	%
Description:	Composition of the ammonia oxidization catalyst
Measured/Calculated /Default	Measured
Source of data	Ammonia oxidization catalyst supplier
Value(s) of monitored parameter	Pt: 95 %, Rh: 5 % Hanwha has been using the Pt 95%, Rh 5% catalyst of Johnson Matthey. Hanwha uses the catalyst which is common practice in the region and supplied by a reputable manufacturer or which composition is reported as being in use in the relevant literature.
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	During the monitoring period
Calculation method (if applicable)	N/A
QA/QC procedures applied:	Not needed

Data / Parameter:	$A_{OR,d}$
Data unit:	tNH_3/day
Description:	Actual ammonia flow rate to the ammonia oxidation reactor
Measured/Calculated	Measured

/Default	
Source of data	Orifice flow meter and differential pressure transmitter
Value(s) of monitored parameter	Maximum flow rate : 87.19 tNH_3/day (Nov 03, 2010) Minimum flow rate : 70.61 tNH_3/day (Jan 20, 2010) ** Permitted range : 88tNH_3/day maximum Refer to the spread sheet and default data
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	• Type : Orifice flow meter and differential pressure transmitter (Maker/ Model : Rosemount/Emerson, 3051CD2A02A1AM5E5S5Q4) with Resistance Temperature Detector (Maker/Model : WISE controls, R221) and Absolute Pressure Transmitter (Maker/Model : Rosemount/Emerson, 3051TG3A2B21AB4E5M5Q4) ● Serial number : Orifice flow meter and differential pressure transmitter : 0120040, 01564836 (Instrument No. 10-FT-502) Resistance Temperature Detector : 07011910 (Instrument No. 10-TT-102) Absolute Pressure Transmitter 1210001, 01624987 (Instrument No. 10-PT-302 ● Accuracy class : according to the supplier's specification Orifice flow meter and differential pressure transmitter: ±0.065% of full scale Resistance Temperature Detector : ±0.55 deg C Absolute Pressure Transmitter : ±0.065% of full scale ● Calibration frequency : 15 months ● Date of last calibration Orifice flow meter and differential pressure transmitter: August 9, 2010 Resistance Temperature Detector : August 9, 2010 Absolute Pressure Transmitter: August 9, 2010 ● Validity : Orifice flow meter and differential pressure transmitter: November 8, 2011 Resistance Temperature Detector : November 8, 2011 Absolute Pressure Transmitter : November 8, 2011 ● Measuring point : NH_3 air mixer ● Measuring range : 0-6,000 Nm^3/
Measuring/Reading/ Recording frequency	● Measuring frequency : Continuously ● Reading frequency : Continuously ● Recording frequency : Continuously (Hourly average)
Calculation method (if applicable)	If the daily ammonia input to oxidation reactor ($A_{OR,d}$) exceeds maximum historical ammonia input to oxidation reactor ($A_{OR,hist}$), the baseline N_2O emissions for that period are capped at 4.5kg N_2O/tonne of nitric acid conservatively applying the IPCC default value.
QA/QC procedures to be applied:	Hanwha's maintenance and testing regime including calibration based on the vendor requirement.

Data / Parameter:	$EI_{RCS,y}$
Data unit:	MWh/yr
Description:	Additional electricity input for running the DeN_2O unit
Measured/Calculated /Default	Measured
Source of data	Wattmeter or electricity accumulator
Value(s) of monitored parameter	350,840 KWh (01/January/2010—31/Dec/2010) Refer to the spread sheet

Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Leakage
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	● Type : (Maker/Model : LS Industrial System/WL32STE) ● Serial number : 0138331 ● Accuracy class : 2.0 grade ● Calibration frequency : PF 1.0(±2.0), PF0.5(±2.5) at the rated current ● Date of last calibration : August 10, 2010 ● Validity : 2 years 6 months ● Measuring point : At the control panel of DeNO2 Unit ● Measuring range : 3,000 rev/kWh
Measuring/Reading/ Recording frequency	● Measuring frequency : Continuously ● Reading frequency : Continuously ● Recording frequency : Continuously
Calculation method (if applicable)	N/A
QA/QC procedures applied:	Instead of calibration, it is replaced by certified new one before to be finished its validity.

Data / Parameter:	$Q_{NG,y}$
Data unit:	Nm^3
Description:	Hydrocarbon (natural gas) input
Measured/Calculated /Default	Measured
Source of data	Integral Orifice meter with temperature, pressure compensation
Value(s) of monitored parameter	171,258.70 Nm^3 (01/January/2010-31/Dec/2010) Refer to the spread sheet
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	● Type : Differential pressure transmitter with pressure,/temperature applincation for compensation(Maker/Model : Honeywell, YSMA125-E1H-00000-1C,CC,F1,MB,MC,S3,(SM)+XXXX) ● Serial number : C2932575001001 (Insrtument No. 10-FT-563) ● Accuracy class : ±1.00809% of full scale, according to the supplier's specification ● Calibration frequency : 15 months, ● Date of last calibration : March 31, 2010 ● Validity : June 30, 2011 ● Measuring point : At the Burner Inlet of DeN2O unit ● Measuring range : 0~100 Nm3/hr
Measuring/Reading/ Recording frequency	● Measuring frequency : Continuously ● Reading frequency : Continuously ● Recording frequency : Continuously (Hourly average)
Calculation method (if applicable)	N/A
QA/QC procedures to be applied:	Hanwha's maintenance and testing regime including calibration based on the vendor requirement.

Data / Parameter:	C_{HNC}
Data unit:	%
Description:	Methane content of hydrocarbon (natural gas)
Measured/Calculated /Default	Measured

Source of data	Hydrocarbon supplier
Value(s) of monitored parameter	91.346667 %
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Data from local supplier, Kyungdong City Gas Corporation
Measuring/Reading/ Recording frequency	● Measuring frequency : Monthly ● Reading frequency : N/A ● Recording frequency : N/A
Calculation method (if applicable)	N/A
QA/QC procedures to be applied:	N/A

Data / Parameter:	$Q_{NMHC,y}$
Data unit:	Nm^3
Description:	Hydrocarbon (Non-methane part of the natural gas) input
Measured/Calculated /Default	Calculated
Source of data	Calculated by the flow rate and the methane content of the natural gas
Value(s) of monitored parameter	14,819.59 Nm^3
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	This parameter is calculated as follows; $Q_{NMHC,y} = Q_{NG,y} * (1 - C_{HNC}/100)$
QA/QC procedures to be applied:	N/A

Data / Parameter:	$Q_{HNC,y}$
Data unit:	Nm^3
Description:	Methane (Methane part of the natural gas) used
Measured/Calculated /Default	Calculated
Source of data	Calculated by the flow rate and the methane content of the natural gas
Value(s) of monitored parameter	156,439.11 Nm^3
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	This parameter is calculated as follows; $Q_{HNC,y} = Q_{NG,y} * C_{HNC}/100$ { 230,313.20 * (91.281667/100) }
QA/QC procedures to be applied:	N/A

Data / Parameter:	ρ_{NG}
Data unit:	t/Nm^3
Description:	Density of the hydrocarbon (natural gas).
Measured/Calculated /Default	Measured
Source of data	Hydrocarbon supplier
Value(s) of monitored parameter	0.0007967 t/Nm^3
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	Data from local supplier, Kyungdong City Gas Corporation
Measuring/Reading/ Recording frequency	● Measuring frequency : Monthly ● Reading frequency : N/A ● Recording frequency : N/A
Calculation method (if applicable)	N/A
QA/QC procedures to be applied:	N/A

Data / Parameter:	ρ_{HNC}
Data unit:	t/Nm^3
Description:	Density of the hydrocarbon (Methane part of the natural gas).
Measured/Calculated /Default	Calculated
Source of data	Theoretical calculation
Value(s) of monitored parameter	0.000714 t/Nm^3
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/	N/A

Recording frequency	
Calculation method (if applicable)	0.000714 t/Nm^3 (=16gCH_4/22.4) This parameter is shown by the density in normal condition (0 ^oC,1atm)
QA/QC procedures to be applied:	N/A

Data / Parameter:	ρ_{NMHC}
Data unit:	t/Nm^3
Description:	Density of the hydrocarbon (Non-methane part of the natural gas).
Measured/Calculated /Default	Calculated
Source of data	Calculated by data of the natural gas and methane
Value(s) of monitored parameter	0.001669701 t/Nm^3
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	This parameter is calculated as follows; $\rho_{NMHC} = (\rho_{NG} - \rho_{HNC} * C_{HNC}/100)/ (1-(C_{HNC}/100)$ (0.0007967 − 0.000714 * 0.91346667) / (1 − 0.91346667)
QA/QC procedures to be applied:	N/A

Data / Parameter:	NCV_{NG}
Data unit:	$Kcal/Nm^3$
Description:	Net calorific value of the natural gas
Measured/Calculated /Default	Measured
Source of data	Hydrocarbon supplier
Value(s) of monitored parameter	10,405.05 $kcal/Nm^3$
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	● Measuring frequency : Monthly ● Reading frequency : N/A ● Recording frequency : N/A
Calculation method (if applicable)	N/A
QA/QC procedures to be applied:	N/A

Data / Parameter:	EF_{NG}
Data unit:	tCO_2/tNG
Description:	Emission factor of the hydrocarbon
Measured/Calculated /Default	Calculated
Source of data	IPCC 1996 GHG Inventory Guidelines and data provided by the natural gas supplier
Value(s) of monitored parameter	3.0672264671 tCO_2/tNG
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	This parameter is calculated as follows; $EF_{NG} = COEF_{NG} * 44/12 * NCV_{NG} * 4.18605/\rho_{NG} * 10^{-9}$ where $COEF_{NG}$: Hydrocarbon emission factor [tC/TJ] 15.3[tC/TJ]by IPCC 1996 GHG Inventory Guidelines $(15.3 * 44/12 * 10405.75 \times 4.18605/0.0007967 \times 10^{-9})$
QA/QC procedures applied	N/A

Data / Parameter:	EF_{HNC}
Data unit:	tCO_2/tCH_4
Description:	Emission factor of methane
Measured/Calculated /Default	Calculated
Source of data	Theoretical calculation
Value(s) of monitored parameter	2.75(tCO_2/tCH_4)
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	2.75(tCO_2/tCH_4) =(44 gCO_2/16gCH_4)
QA/QC procedures applied:	N/A

Data / Parameter:	EF_{NMHC}
Data unit:	$tCO_2/tNMHC$
Description:	Emission factor of hydrocarbon (Non-methane part of the natural gas)
Measured/Calculated /Default	Calculated

Source of data	Calculated by data of the natural gas and methane
Value(s) of monitored parameter	4.499210 tCO_2/tNMHC
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	This parameter is calculated as follows; $EF_{NMHC} = (EF_{NG} * \rho_{NG} - EF_{HNC} * \rho_{HNC} * C_{HNC}/100)/ (1 - C_{HNC}/100)/ \rho_{NMHC}$ ((15.3*44/12*10405.75*4.18605/0.0007967/1000000000*0.0007967)-(2.75*0.000714*0.91346667))/(1-0.91346667)/((0.0007967-0.000714*0.91346667)/(1-0.91346667))
QA/QC procedures applied:	N/A

Data / Parameter:	$Type_{HC}$
Data unit:	-
Description:	Hydrocarbon (natural gas) supplier information
Measured/Calculated /Default	Measured
Source of data	Hydrocarbon supplier
Value(s) of monitored parameter	Data from local supplier, Kyungdong City Gas Corporation
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Project
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	N/A
QA/QC procedures applied:	N/A

Data / Parameter:	$QR_{N2O,y}$
Data unit:	tN_2O
Description:	Regulation based on annual quantity N_2O limited
Measured/Calculated /Default	Measured
Source of data	National environmental legislation in the Republic of Korea In case national regulations concerning N_2O emissions are implemented during the crediting period, the impact on baseline N_2O emissions is considered without any delay by adjusting the measured N_2O emissions at the time the regulation has to be implemented.
Value(s) of monitored parameter	N/A Baseline N_2O emissions are limited by the absolute quantity of N_2O emissions given by the regulation.

	If the measured baseline N_2O emissions are exceeding the regulatory limit, then measured baseline N_2O emissions are substituted by the regulatory limit. If, $QI_{N2O,y} > QR_{N2O,y}$ then, $BE_{N2O,y} = QR_{N2O,y}$ else, $BE_{N2O,y}$ = min of [$QI_{N2O,y}$, $SE_{N2O,y}$ * $P_{product,max}$] where: $QI_{N2O,y}$: Quantity of N_2O emissions at the inlet of the destruction facility in year y (tN_2O) $QR_{N2O,y}$: Regulatory limit of N_2O emissions in year y (tN_2O) $BE_{N2O,y}$: Baseline emissions of N_2O in year y (tN_2O) $SE_{N2O,y}$: Specific N_2O emissions per unit of output of nitric acid in year y ($tN_2O/tHNO_3$) $P_{product,y}$: Production of nitric acid in year y ($tHNO_3$) The quantity of N_2O emissions at the inlet of the N_2O destruction facility (DF) is calculated based on continuous measurement of the tail gas volume flow rate and the N_2O concentration at the inlet of the N_2O destruction facility.
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	N/A
QA/QC procedures applied:	N/A

Data / Parameter:	*$RSE_{N2O,y}$*
Data unit:	$tN_2O/tHNO_3$
Description:	Regulation based on N_2O emissions per unit of nitric acid
Measured/Calculated /Default	Measured
Source of data	National environmental legislation in the Republic of Korea In case national regulations concerning N_2O emissions are implemented during the crediting period, the impact on baseline N_2O emissions is considered without any delay by adjusting the measured N_2O emissions at the time the regulation has to be implemented.
Value(s) of monitored parameter	N/A Regulation setting of a threshold for specific N_2O emissions per unit of product If, $SE_{N2O,y} > RSE_{N2O}$ then, $BE_{N2O,y}$ = min of [RSE_{N2O} *$P_{product,y}$, $SE_{N2O,y}$ *$P_{product,max}$] else, $BE_{N2O,y}$ = min of [$QI_{N2O,y}$, $SE_{N2O,y}$ *$P_{product,max}$] where: $SE_{N2O,y}$: Specific N_2O emissions per unit of output of nitric acid in year y ($tN_2O/tHNO_3$) RSE_{N2O} : Regulatory limit of N_2O emissions per unit of output of nitric acid ($tN_2O/tHNO_3$) $BE_{N2O,y}$: Baseline emissions of N_2O in year y (tN_2O) $P_{product,y}$: Production of nitric acid in year y ($tHNO_3$) $QI_{N2O,y}$: Quantity of N_2O emissions at the inlet of the destruction facility in

	year y (tN_2O) The specific N_2O emissions per unit of output of nitric acid is defined as: $SE_{N2O,y} = QI_{N2O,y} / P_{product,y}$ where: $SE_{N2O,y}$: Specific N_2O emissions per unit of output of nitric acid in year y ($tN_2O/tHNO_3$) $QI_{N2O,y}$: Quantity of N_2O emissions at the inlet of the destruction facility in year y (tN_2O) $P_{product,y}$: Production of nitric acid in year y ($tHNO_3$) The quantity of N_2O emissions at the inlet of the N_2O destruction facility is calculated based on continuous measurement of the tail gas volume flow rate and the N_2O concentration at the inlet of the N_2O destruction facility.
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	N/A
QA/QC procedures applied:	N/A

Data / Parameter:	$CR_{N2O,y}$
Data unit:	tN_2O/m^3
Description:	Regulation based on N_2O concentration in tail gas limited
Measured/Calculated /Default	Measured
Source of data	National environmental legislation in the Republic of Korea In case national regulations concerning N_2O emissions are implemented during the crediting period, the impact on baseline N_2O emissions is considered without any delay by adjusting the measured N_2O emissions at the time the regulation has to be implemented.
Value(s) of monitoring parameter	N/A Regulation setting of a threshold for N_2O concentration in the tail gas. If, $CN_{2O,y} > CR_{N2O}$ then $BE_{N2O,y} = \sum_{i=1}^{n} C_{N2O,i} * [F_{TG,i} * M_i]$ where $C_{N2O,i}$ is min [C_{N2O},y, CR_{N2O}, and {($SE_{N2O,y}$ *$P_{product,max}$)/(sum($F_{TE,i}$ * M_i)}] else, $BE_{N2O,y} = QI_{N2O,y}$ where: $C_{N2O,I}$: N_2O concentration a destruction facility inlet during interval i (tN_2O/m^3) $CR_{N2O,i}$: Regulatory limit for specific N2O concentration during interval i (tN_2O/m^3) $BE_{N2O,y}$: Baseline emissions of N_2O in year y (tN_2O) $F_{TE,i}$: Volume flow rate at the exit of the destruction facility during interval i (m^3/h) M_i : Length of measuring interval i (h) i : interval n : number of intervals during the year $QI_{N2O,y}$: Quantity of N_2O emissions at the inlet of the destruction facility in

	year y (tN_2O) The quantity of N_2O emissions at the inlet of the N_2O destruction facility is calculated based on continuous measurement of the tail gas volume flow rate and the N_2O concentration at the inlet of the N_2O destruction facility.
Indicate what the data are used for (Baseline/Project/Leakage emission calculations)	Baseline
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	N/A
QA/QC procedures applied:	N/A

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

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It has been checked that there are no Korean regulation in place that would limit the quality 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 measurement of the N_2O at the inlet of DeNOx unit, which results in a conservative estimation of baseline emissions.

Baseline emissions are limited to the design capacity of the nitric acid plant, According to AM0028 version 3, the design capacity is measured in tons of nitric acid per year. The actual nitric acid production in the covered monitoring period does not exceed the design capacity.

$$BE\_y = \text{Minimum}(P_{product,max}\ \ P_{product,y}) / P_{product,y} * \sum_{i=1}^{n} [F_{TI,i} * CI_{N2O,i} * M_i * GWP_{N2O}]$$

- i : Interval,
- n : Number of intervals during the year (1/yr),
- $F_{TI,i}$: Volume flow rate at the inlet of the destruction facility during interval i (Nm^3/h),
- $CI_{N2O,i}$: N_2O concentration a destruction facility inlet during interval i(tN_2O/Nm^3),
- M_i : Measuring interval (1 hour)
- GWP_{N2O} : Global warming potential of N_2O,
- $P_{product,max}$: Design capacity ($tHNO_3$/yr), and
- $P_{product,y}$: Production of nitric acid in a year y ($tHNO_3$/yr).

If the actual average daily operating temperature and/or pressure in the ammonia oxidation reactor (T_g and P_g) are outside a “permitted range” of operating temperatures and/or pressures ($T_{g,hist}$ and $P_{g,hist}$), or the daily ammonia input to the oxidation reactor($A_{OR,d}$) exceeds maximum historical ammonia input to oxidation reactor ($A_{OR,hist}$), the baseline N_2O emissions for that period are capped at 4.5kgN_2O/tonne of nitric acid conservatively applying the IPCC default value.

Furthermore, as for composition of ammonia oxidation catalyst, the plant operator is allowed to use compositions of ammonia oxidation catalysts that are common practice in the region or have been used in the nitric acid production plant during the last three years without limitation of N_2O baseline emissions.

In case the nitric acid production plant operator wishes to change to a composition not used during the last three years, but is common practice in the region and supplied by a reputable manufacturer, or if it corresponds to a composition that is reported as being in use in the relevant literature, the plant operator is allowed to use these ammonia oxidation catalysts without limitation of N_2O baseline emissions.

In case the nitric acid production plant operator changes the composition of ammonia oxidation catalysts and the composition is not common practice in the region and not reported as being in use in the relevant literature, the project applicant has to demonstrate (either by economic or other arguments) that the choice of the new composition was based on considerations other than an attempt to increase the rate of N_2O production. If the project applicant can demonstrate appropriate and verifiable reasons, the plant operator is allowed to use new ammonia oxidation catalysts without limitation of N_2O baseline emissions.

The first composition of ammonia oxidation catalyst used during the crediting period shall be of the same kind of catalyst composition already in operation in the specific nitric acid production plant. This is to avoid gaming at the beginning of the project activity.

In case the nitric acid production plant operator changes the composition of ammonia oxidation catalysts and the composition is not common practice in the region and not reported as being in use in the relevant literature, and the project applicant cannot demonstrate appropriate and verifiable reasons for this baseline emissions are limited to the maximum specific N_2O emissions of previous periods ($tN_2O/tHNO_3$), documented in the verified monitoring reports.

Required monitoring parameters:

- G_{sup} : Supplier of the ammonia oxidation catalyst
- $G_{sup,hist}$: Historical supplier of the ammonia oxidation catalyst
- G_{com} : Composition of the ammonia oxidation catalyst
- $G_{com,hist}$: Historical composition of the ammonia oxidation catalyst
- $SE_{N2O,y}$: Specific N_2O emissions per ton HNO_3 of product of nitric acid in year y ($tN_2O/tHNO_3$)

In the event that N_2O concentrate of outlet of DeN_2O facility is not within the monitoring range, we apply the IPCC default value for that period.

In the event that the monitoring system is down, the lowest between the conservative default value established in the methodology or the last measured by-product rate (whichever the lower) will be valid and applied for the downtime period for the baseline emission factor, and the highest measured by-product rate during the project activity will be applied for the downtime period for the campaign emission factor.

$$BE\_y = \text{Minimum}(P_{product,max}\ \ P_{product,y}) / P_{product,max} * \sum_{i=1}^{n} [F_{TI,i} * CI_{N2O,i} * M_i * GWP_{N2O}]$$

= <u>279,683.18 tCO_2e</u>

E.2. Project emissions calculation

>>

The emissions due to the project activity are composed of (a) the emission of not destroyed N_2O and (b) emissions from auxiliary hydrocarbons input resulting from the operation of the nitric acid plant. 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 nitric acid plant and the volume flow rate of the tail gas stream. 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 nitric acid plant.
Project emissions are limited to the design capacity of the nitric acid plant. According to AM0028 version 3, the design capacity is measured in tons of nitric acid per year. The actual nitric acid production in the covered monitoring period does not exceed the design capacity.

$$PE\_y = PE_{ND,y} + PE_{DF,y}$$
$$= PE_{ND,y} + HCE_{C,y} + HCE_{NC,y}$$

$PE_{ND,y}$: Project emissions from N_2O not destroyed in year y (tCO_2e/yr),
$PE_{DF,y}$: Project emissions related to the operation of the destruction facility in year y (tCO_2e/yr)
$HCE_{C,y}$: Converted hydrocarbon emissions in year y (tCO_2/yr),
$HCE_{NC,y}$: Methane emissions in year y (tCO_2e/yr)

$$PE_{ND,y} = \sum_{i=1}^{n} [F_{TE,i} * CO_{N2O,i} * M_i * GWP_{N2O}]$$

i : Interval,
n : Number of intervals during the year (1/yr)
$F_{TE,i}$: Volume flow rate at the exit of the destruction facility during interval i(Nm^3/h),
$CO_{N2O,i}$: N_2O concentration in the tail gas of the N_2O destruction facility during interval i (tN_2O/Nm^3),
M_i : Length of measuring interval i (h),
GWP_{N2O} : Global warming potential of N_2O.

$$PE_{ND,y} = \sum_{i=1}^{n} [F_{TE,i} * CO_{N2O,i} * M_i * GWP_{N2O}]$$
= **35,290.20 tCO_2e**

In the event that the monitoring system is down, the highest measured by-product rate during the project activity will be applied for the downtime period for the campaign emission factor.

$$HCE_{C,y} = \rho_{NMHC} * Q_{NMHC,y} * OXID_{NMHC}/100 * EF_{NMHC} + \rho_{HNC} * Q_{HNC,y} * OXID_{CH4}/100 * EF_{HNC}$$
$$= \rho_{NMHC} * Q_{NMHC,y} * EF_{NMHC}$$

$$HCE_{NC,y} = \rho_{HNC} * Q_{HNC,y} * (1 - OXID_{CH4}/100) * GWP_{CH4}$$
$$= \rho_{HNC} * Q_{HNC,y} * GWP_{CH4}$$

ρ_{NMHC} : Hydrocarbon (Non-methane part of the natural gas) density ($tNMHC/Nm^3$),
$Q_{NMHC,y}$: Hydrocarbon (Non-methane part of the natural gas) input in year y (Nm^3),
$OXID_{NMHC}$:Oxidation factor of hydrocarbon (Non-methane part of the natural gas) (%),
EF_{NMHC} : Carbon emissions factor of hydrocarbon (Non-methane part of the natural gas) ($tCO_2/tNMHC$),
ρ_{HNC} : Methane (Methane part of the natural gas) density (tCH_4/Nm^3),
$Q_{HNC,y}$: Methane (Methane part of the natural gas) used in year y (Nm^3)

EF_{HNC} : Carbon emissions factor of methane (Methane part of the natural gas) (tCO_2/tCH_4),
$OXID_{CH4}$: Oxidation factor of methane(Methane part of the natural gas) (%), and
GWP_{CH4} : Global warming potential of methane.

For this project, fraction of Methane not converted is not being measured due to unreasonable costs. So, 0% is applied to $OXID_{CH4}$ and 100% is applied to $OXID_{NMHC}$.

$HCE_{C,y} = \rho_{NMHC} * Q_{NMHC,y} * OXID_{NMHC}/100 * EF_{NMHC} + \rho_{HNC} * Q_{HNC,y} * OXID_{CH4}/100 * EF_{HNC}$
$= \rho_{NMHC} * Q_{NMHC,y} * EF_{NMHC}$
= <u>111.33 tCO_2e (non-methane)</u>

$HCE_{NC,y} = \rho_{HNC} * Q_{HNC,y} * (1 - OXID_{CH4}/100) * GWP_{CH4}$
$= \rho_{HNC} * Q_{HNC,y} * GWP_{CH}$
= <u>2,345.65tCO_2e (methane)</u>.

Therefore, total value of Project Emission is calculated as follows :

PE_y = $PE_{ND,y} + PE_{DF,y}$
= $PE_{ND,y} + HCE_{C,y} + HCE_{NC,y}$
= 35,290.20 + 111.33 + 2,345.65
= <u>37,747.18 tCO_2e</u>

E.3. Leakage calculation

>>

Additional power such as DeN_2O unit running will be needed by the project implementation. The CO_2 emission related to the electricity consumption is insignificant, but monitored and counted as leakage in conservative manner.

LE_y = $EI_{RCS,y} * EF_{RCS}$

$EI_{RCS,y}$: Additional electricity input for running the DeN_2O unit (MWh/yr), and
EF_{RCS} : Emissions factor for running the DeN_2O unit.

LE_y = $EI_{RCS,y} * EF_{RCS}$
= **<u>217.52 tCO_2e</u>**

E.4. Emission reductions calculation / table

>>

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

Total baseline emissions: : **279,683.18 tCO_2e**
Total project emissions: **37,747.18 tCO_2e**
Total leakage: **217.52 tCO_2e**
Total emission reductions: **241,718.48 tCO_2e**

In terms of the approved methodology (AM0028 version 3), the emission reduction (ER_y) by the project activity during a given period "y" is the difference between the baseline emission (BE_y) and project emission (PE_y), as follows ;

ER_y = BE_y - PE_y - LE_y

= 279,683.18 - 37,747.18 - 217.52

= <u>241,718.48 tCO_2e</u>

The total amount of emission reductions is calculated as **<u>241,718tons CO_2e.</u>**

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

>>

Table : Comparison of emission reductions with PDD values

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	**281,272 tCO_2e**	**241,718 tCO_2e**

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

>>

Compared to PDD, value of emission reductions was reduced around 14% from 281,272 tCO_2e to 241,718 tCO_2e. This is because (a) DeN2O unit was not operated about 23 days during the period due to the replacement of primary catalyst or maintenance, (b) nitric acid production during the period was reduced around 10% and (c) a destruction rate during the period was reduced from 90% to 87.4% due to the problem of the catalyst.

= End =

Annex-1 Environmental issues

1. Environmental Impacts

According to the national Environmental Law in Korea, Environmental Impacts are :

Gaseous matter : There is no additional pollution. The N_2O destructed into harmless N_2 and O_2.

Particular matter : There is no additional pollution.

Water matter : Not applicable. The destruction reaction occurs in gaseous phase.

Spent catalyst : The catalyst over its lifetime is recycled to get precious components and then reproduced to new catalyst. The catalyst has a long lifetime.

No transboundry impacts are expected.

2. N_2O Regulation in Korea

No national regulation for N_2O emission. We periodically visit the web-site of the concerned ministry in Korea and check the regulation. In case the regulation is updated, we will follow it accordingly.

3. NOx Regulation in Korea

National regulation for NOx emission is Clean Conservation Act (CCA) of the Republic of Korea. According to CCA, currently, NOx regulation requires to limit the emission below 200ppmv. We are periodically visiting the web-site of CCA and check the regulation. In case the regulation is updated, we will follow it accordingly. During the period of 01/January/2010 to 31/December/2010, the average value of NOx is 56 ppmv the maximum value 196.35 ppmv (on 23/October/2010).

= End =

Annex-2 Daily events, checking against baseline requirements

1 Operating Temperature

The actual average daily operating temperature in the ammonia oxidation reactor was within the permitted range for all days covered by this monitoring report, except for 3 days from July 19, 2010 to July 21, 2010..

Parameters are Annex-1

2. Operating Pressure

The actual average daily operating pressure in the ammonia oxidation reactor was within the permitted range for all days covered by this monitoring report, except for the followings 5 days :

.November 24-26, 2010

November 28, 2010

December 15, 2010

Parameters are Annex-1

3. Composition of the Ammonia Oxidation Catalyst

The composition of the ammonia oxidation catalyst is the same kind of catalyst composition already in operation prior to the start of the project activity.

4. Ammonia Flow Rate to the Ammonia Oxidation Reactor

The daily ammonia input to the ammonia oxidation reactor does not exceed the maximum permitted daily ammonia input.

Parameters are Annex-1

5. Production of Nitric Acid

Production volume of Nitric Acid during the project period is 95,409.3943tons, which is calculated as

--- 146,783.6835tons x 65% = 95,409.3943tons

--- 146,783.6835tons is the production volume of HNO_3 which includes H_2O as 35%. Therefore we shall exclude H_2O and come to the pure $HNO_{3\ \text{production volume.}}$ 95,409.3943tons

whereas, $P_{product,max}$ specified in the PDD, based on the manufacturer's specification is 107,100tons, which is 306 [HNO_3/day]*350[day/yr]. Therefore, during the period, maximum production is calculated as

306 x 350 = 107,100tons.

Thus actual production of 95,409.3943tons is less than 107,100tons.

Daily basis production during the period was also within the permitted range, mentioned in the PDD.

Meantime, the operation of Nitric Acid Plant was stopped 23 days during the following period as below :

February 25–26 (Emergency stoppage)

March 01-02 (Power failure)

March 28 – April 07 (Replacement of primary catalyst and DeN_2O catalyst)

June 08-09 (Power failure)

July 24-25 (Power failure)

August 15-20 (Replacement of primary catalyst)

October 22-23 (Power failure)

December 20-23 (Replacement of primary catalyst)

6. Shutdown of De N_2O unit

The De N_2O unit was operated to reduce the N_2O gas from nitric acid plant, except for 23 days, the same as above item-5.

= End =

Annex-3 Details of monitoring instrument

Information of monitoring instrument is as below :

(1) AOR instrument

1	Actual ammonia input to oxidation reactor (tNH_3/day) *)reported in tons	**10-FT-502**	Differential Pressure Transmitter	0 - 1,600 mmH_2O Compensated Flow range 0- 6,000 Nm3/hr	±0.065% of full scale	Continuous	Daily	Manufacturer : Rosemount/Emerson Model No. : 3051CD2A02A1AM5E5S5Q4 Instrument No. : 01210040	Aug 09 / 2010 - Nov 09 / 2011	Interval : 15 months External Entity : Hyupsung HISCO
		10-PT-302	Absolute Pressure Transmitter	0 - 16 bar	±0.065% of full scale	Continuous		Manufacturer : Rosemount/Emerson Model No. : 3051TG3A2B21AB4E5M5Q4 Instrument No. : 01210001	Aug 09 / 2010 - Nov 09 / 2011	Interval : 15 months External Entity : Hyupsung HISCO
		10-TT-102	RTD(Pt 100 ohm) Resistance Temperature Detector	0 - 500 deg C	±0.55 deg C	Continuous		Manufacturer : WISE controls Model No. : R221 Instrument No. : 07011910	Aug 09 / 2010 - Nov 09 / 2011	Interval : 15 months External Entity : Hyupsung HISCO
		10-FT-502	Differential Pressure Transmitter	0 - 1,600 mmH_2O Compensated Flow range 0- 6,000 Nm3/hr	±0.065% of full scale	Continuous	Daily	Manufacturer : Rosemount/Emerson Model No. : 3051CD2A02A1AM5E5S5Q4 Instrument No. : 01564836	July 20 / 2009 - Oct 20 / 2010	Interval : 15 months External Entity : Hyupsung HISCO
		10-PT-302	Absolute Pressure Transmitter	0 - 16 bar	±0.065% of full scale	Continuous		Manufacturer : Rosemount/Emerson Model No. : 3051TG3A2B21AB4E5M5Q4 Instrument No. : 01624987	July 20 / 2009 - Oct 20 / 2010	Interval : 15 months External Entity : Hyupsung HISCO
		10-TT-102	RTD(Pt 100 ohm) Resistance Temperature Detector	0 - 500 deg C	±0.55 deg C	Continuous		Manufacturer : WISE controls Model No. : R221 Instrument No. : 04014993	July 16 / 2009 - Oct 16 / 2010	Interval : 15 months External Entity : Hyupsung HISCO
2	Actual ammonia oxidation temper-ature	**10-TT-115**	T/C (Type R) Thermocouple ((+)Pt/Rh - (-)Pt)	0 - 1,200 deg C	±1.5 deg C	Continuous	Daily	Manufacturer : YOKOGAWA Model No. : YTA 110 Instrument No. : C2D807670435	Aug 09 / 2010 - Nov 09 / 2011	Interval : 15 months External Entity : Hyupsung HISCO
		10-TT-115	T/C (Type R) Thermocouple ((+)Pt/Rh - (-)Pt)	0 - 1,200 deg C	±1.5 deg C	Continuous	Daily	Manufacturer : YOKOGAWA Model No. : YTA 110 Instrument No. : C2E104013 502	July 20 / 2009 - Oct 20 / 2010	Interval : 15 months External Entity : Hyupsung HISCO
3	Actual operating pressure	**10-PT-304**	Absolute Pressure Transmitter	0 - 16 bar	±0.065% of full scale	Continuous	Daily	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S1 Instrument No. : 0552 05121501006	Aug 09 / 2010 - Nov 09 / 2011	Interval : 15 months External Entity : Hyupsung HISCO
		10-PT-304	Absolute Pressure Transmitter	0 - 16 bar	±0.065% of full scale	Continuous	Daily	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S1 Instrument No. : 0729 07062904012	July 20 / 2009 - Oct 20 / 2010	Interval : 15 months External Entity : Hyupsung HISCO
4	Ammonia oxidation catalyst	-	Pt/Rh catalyst	Composition 95% Pt, 5% Rh				Manufacturer : Johnsom Matthey	Nov 24 / 2009 (Invoice No. : SD85431) Apr 06 / 2010 (Invoice No. : SD85749) Aug 20 / 2010 (Invoice No. : SD85989) Dec 22 / 2010 (Invoice No. : SD86244)	
5	Plant output of Nitric Acid *)reported in tons	**10-FT-512**	Magnetic flow meter	0 - 20 m3/hr	±0.5% of full scale	Continuous	Daily	Manufacturer : YAMATAKE Model No. : MGG14C-BB1A-XCXX-YABJ Instrument No. : R-98417-41-011	Jul 28 / 2010 - Oct 28 / 2011	Interval : 15 months External Entity : FM Tech
		10-FT-512	Magnetic flow meter	0 - 20 m3/hr	±0.675% of full scale	Continuous	Daily	Manufacturer : Rosemount/Emerson Model No. : 8705TPA020S1W0N0G3B3Q4 Instrument No. : 0870138304	July 14 / 2009 - Oct 14 / 2010	Interval : 15 months External Entity : FM Tech
			Temperature application for compensation							

(2) AMS instrument

1	N2O concentration at destruction facility inlet	**10-AT-061**	NDIR N2O Analyzer	0 - 3,000 ppmv	±0.02% of full scale	Continuous	Hourly	Manufacturer : ABB Model No. : AO2000 / Uras 26 Instrument No. : 3.346996.7	Jan 23 / 2008 - Apr 23 / 2009 Feb 04 / 2009 - May 04 / 2010 Jan 20 / 2010 - Apr 20 / 2011	Interval : 15 months External Entity : Air Tec (TUV Sud)
2	Volume flow of tailgas at N2O destruction facility inlet	**10-FT-561**	Differential Pressure Transmitter	0 - 275 mmH2O Compensated Flow range 0- 60,000 Nm3/hr	±0.075% of full scale	Continuous	Hourly	Manufacturer : Honeywell Model No. : STD924-E1H-00000-S2 Instrument No. : 0553 05121501009	Aug 09 / 2010 - Nov 09 / 2011	Interval : 15 months External Entity : Hyupsung HISCO
		10-PT-361	Absolute Pressure Transmitter	0 - 16 bar	±0.065% of full scale	Continuous	Hourly	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S1 Instrument No. : 0552 05121501007	Aug 09 / 2010 - Nov 09 / 2011	Interval : 15 months External Entity : Hyupsung HISCO
		10-TT-161	RTD(Pt 100 ohm) Resistance Temperature Detector	0 - 500 deg C	±0.3% of full scale	Continuous		Manufacturer : WISE controls Model No. : R221+ MTM Instrument No. : WS-7M425	Aug 09 / 2010 - Nov 09 / 2011	Interval : 15 months External Entity : Hyupsung HISCO
		10-FT-561	Differential Pressure Transmitter	0 - 275 mmH2O Compensated Flow range 0- 60,000 Nm3/hr	±0.075% of full scale	Continuous	Hourly	Manufacturer : Honeywell Model No. : STD924-E1H-00000-S2 Instrument No. : 0712 07030214004	July 20 / 2009 - Oct 20 / 2010	Interval : 15 months External Entity : Hyupsung HISCO
		10-PT-361	Absolute Pressure Transmitter	0 - 16 bar	±0.065% of full scale	Continuous	Hourly	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S1 Instrument No. : 0712 07030214004	July 20 / 2009 - Oct 20 / 2010	Interval : 15 months External Entity : Hyupsung HISCO
		10-TT-161	RTD(Pt 100 ohm) Resistance Temperature Detector	0 - 500 deg C	±0.3% of full scale	Continuous		Manufacturer : WISE controls Model No. : R221+ MTM Instrument No. : WS-7M139	July 16 / 2009 - Oct 16 / 2010	Interval : 15 months External Entity : Hyupsung HISCO
3	N2O concentration at destruction facility outlet	**10-AT-062**	NDIR N2O Analyzer	0 - 300 ppmv	±0.02% of full scale	Continuous	Hourly	Manufacturer : ABB Model No. : AO2000 / Uras 26 Instrument No. : 3.346996.7	Jan 23 / 2008 - Apr 23 / 2009 Feb 04 / 2009 - May 04 / 2010 Jan 20 / 2010 - Apr 20 / 2011	Interval : 15 months External Entity : Air Tec (TUV Sud)
4	Volume flow of tailgas at N2O destruction facility outlet	**10-FT-562**	Differential Pressure Transmitter	0 - 190 mmH2O Compensated Flow range 0- 60,000 Nm3/hr	±0.075% of full scale	Continuous	Hourly	Manufacturer : Honeywell Model No. : STD924-E1H-00000-S2 Instrument No. : 0553 05121501010	Aug 09 / 2010 - Nov 09 / 2011	Interval : 15 months External Entity : Hyupsung HISCO
		10-PT-362	Absolute Pressure Transmitter	- 0.1 - 0.1 bar	±0.065% of full scale	Continuous	Hourly	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S1 Instrument No. : 9853 00002001004	Aug 09 / 2010 - Nov 09 / 2011	Interval : 15 months External Entity : Hyupsung HISCO
		10-TT-162	RTD(Pt 100 ohm) Resistance Temperature Detector	0 - 500 deg C	±0.3% of full scale	Continuous		Manufacturer : WISE controls Model No. : R221+ MTM Instrument No. : WS-7M423	Aug 09 / 2010 - Nov 09 / 2011	Interval : 15 months External Entity : Hyupsung HISCO
		10-FT-562	Differential Pressure Transmitter	0 - 190 mmH2O Compensated Flow range 0- 60,000 Nm3/hr	±0.075% of full scale	Continuous	Hourly	Manufacturer : Honeywell Model No. : STD924-E1H-00000-S2 Instrument No. : 0712 07030214002	July 20 / 2009 - Oct 20 / 2010	Interval : 15 months External Entity : Hyupsung HISCO
		10-PT-362	Absolute Pressure Transmitter	- 0.1 - 0.1 bar	±0.065% of full scale	Continuous	Hourly	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S1 Instrument No. : 9853 00002001004	July 20 / 2009 - Oct 20 / 2010	Interval : 15 months External Entity : Hyupsung HISCO
		10-TT-162	RTD(Pt 100 ohm) Resistance Temperature	0 - 500 deg C	±0.3% of full scale	Continuous		Manufacturer : WISE controls Model No. : R221+ MTM Instrument No. : WS-7M140	July 16 / 2009 - Oct 16 / 2010	Interval : 15 months External Entity : Hyupsung HISCO

= End =

History of the document

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