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

MONITORING REPORT

Title of the project activity	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 of the project activity	0922
Version number of the monitoring report	1.0
Completion date of the monitoring report	19/07/2012
Registration date of the project activity	03/05/2007
Monitoring period number and duration of this monitoring period	The 6th monitoring period: 01/01/2012 - 30/06/2012
Project participant(s)	·Hanwha Corporation (HWC) ·Mitsubishi Corporation (Korea) Ltd. ·Mitsubishi Corporation
Host Party(ies)	Republic of Korea
Sectoral scope(s) and applied methodology(ies)	·Category 5: Chemical industries. ·AM0028 version 3: “Catalytic N_2O destruction in the tail gas of Nitric Acid or Caprolactam production plants --- version 3”.
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	281,272 tCO_2e / year (365 days)
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	155,575 tCO_2e / 182 days

SECTION A. Description of project activity

A.1. Purpose and general description of 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. Total emission reductions achieved in this monitoring period (01/01/2012 – 30/06/2012) :
   155,575 ton:

A.2. Location of project activity

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(a) Host Party(ies);

Republic of Korea

(b) Region/ State/ Province, etc.;

(c) City/ Town/ Community, etc.;

753-22 Onsan eup, Ulju gun, Ulsan city, 689-892

(d) Physical/ Geographical location.

35.2043, 129.1223 (Latitude 35.2043 north and Longitude +129.1223 east)

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Republic of Korea (host)	**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.
Switzerland	**Hanwha Corporation**	No.

A.4. Reference of applied methodology

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(a) The applied methodology(ies)

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

(b) Any tools and other methodologies to which the applied methodology(ies) refers

Tool for demonstration and assessment of additionality" (Version 01)

A.5. Crediting period of project activity

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The start date of Crediting period is 27/06/2007 (changed by post-registration request).
7 year crediting period with twice renewal (total 21 years) was selected for the project activity.
It was changed from July 1, 2007 – June 30, 2014 and such change was approved by UNFCCC on January 29, 2008.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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1. The starting date of operation of the project activity.
   Starting date of the project activity: 27/06/2007

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. Post registration changes

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

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No deviations from registered monitoring plan.

B.2.2 Corrections

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No corrections.

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

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No permanent changes from registered monitoring plan

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

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No changes to project design of registered project activity.

B.2.5. Changes to start date of crediting period

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The start date of Crediting period is 27/06/2007 (changed by post-registration request).
7 year crediting period with twice renewal (total 21 years) was selected for the project activity.
It was changed from July 1, 2007 – June 30, 2014 and such change was approved by UNFCCC on January 29, 2008.

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

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No.

SECTION C. Description of monitoring system

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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 :

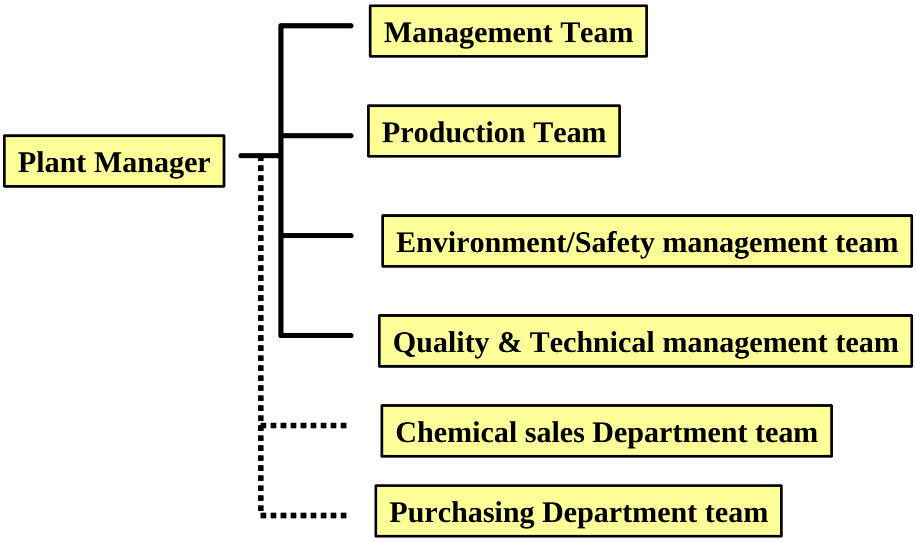
Para-meter	Data description	Data generation	Measured by		Aggregation/Recording		Calcu-lation		Reporting
$CI_{N2O,i}$	N2O concentration at destruction facility inlet.	Inlet of DeN2O	Non-dispersion infrared absorption analyzer		ABB data logging system		Excel spread sheet (Accor-ding to AM0028)		By Hanwha 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						
$EIRCS_{,y}$	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:



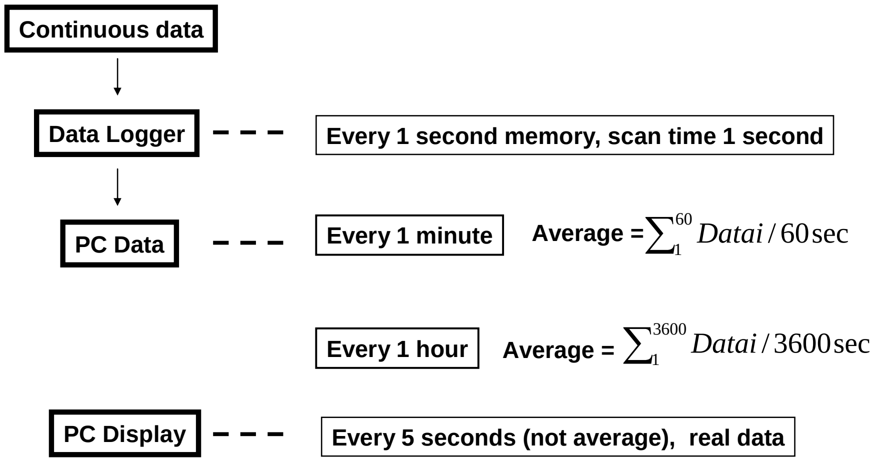
4. Emergency procedures for the monitoring system

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)
Natural Gas Flow to Destruction Facility	10-FT-563(F1563)
Ammonia Flow to AOR	10-FT-502(F1502)
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 fixed ex ante or at renewal of crediting period

Data / Parameter	***GWP*$_{N2O}$**
Unit	tCO_2e/tN_2O
Description	Global warming potential of the nitric oxide
Source of data	IPCC, The Second Assessment Report
Value(s) applied	310, as specified in the methodology
Purpose of data	Baseline/Project
Additional comment	N/A

Data / Parameter	***GWP*$_{CH4}$**
Unit	tCO_2e/tCH_4
Description	Global warming potential of the methane
Source of data	IPCC, The Second Assessment Report
Value(s) applied	21, as specified in the methodology
Purpose of data	Project
Additional comment	N/A

Data / Parameter	**Reg_{Nox}**
Unit	tNO_X/m^3
Description	National regulation on NO_X emissions to be checked and applied
Source of data	National environmental legislation in the Republic of Korea
Value(s) applied	$2.92 * 10^{-7}$ (tNO_X/m^3) Clean Air Conservation Act of the Republic of Korea Currently, NO_X regulation requires limiting the emissions below 200 ppmv.
Purpose of data	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* $_{product, max}$**
Unit	$tHNO_3/yr$
Description	Design capacity of nitric acid production of the targeted line
Source of data	Manufacturer’s specification
Value(s) applied	107,100 $tHNO_3/yr$
Purpose of data	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	$T_{g,hist}$
Unit	°C
Description	Historical operating temperature range of the ammonia oxidation reactor
Source of data	Production reports Daily average temperature from hourly snapshot data.
Value(s) applied	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.
Purpose of data	Baseline
Additional comment	N/A

Data / Parameter	$P_{g,hist}$
Unit	Pa
Description	Historical operating pressure range of the ammonia oxidation reactor
Source of data	Production reports Daily average pressure from hourly snapshot data.
Value(s) applied	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.
Purpose of data	Baseline
Additional comment	N/A

Data / Parameter	$G_{sup,hist}$

Unit	-
Description	Historical supplier's information of the ammonia oxidization catalyst
Source of data	Ammonia oxidization catalyst supplier
Value(s) applied	Name of the supplier: Johnson Matthey
Purpose of data	Baseline
Additional comment	N/A

Data / Parameter	$\boldsymbol{G}_{\mathbf{com,hist}}$
Unit	%
Description	Historical composition of the ammonia oxidization catalyst
Source of data	Ammonia oxidization catalyst supplier
Value(s) applied	Pt: 95%, Rh: 5%
Purpose of data	Baseline
Additional comment	N/A

Data / Parameter	$\boldsymbol{SE}_{\mathbf{N2O}}$
Unit	$kgN_2O/tHNO_3$
Description	N_2O emission rate per ton of nitric acid
Source of data	Pre-publication Draft 2006 IPCC Guidelines accepted by the 21st Session of the IPCC
Value(s) applied	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)
Purpose of data	Baseline
Additional comment	N/A

Data / Parameter	$\boldsymbol{A}_{\mathbf{OR,hist}}$
Unit	tNH_3/day
Description	Maximum of historical ammonia flow rate of the ammonia oxidization reactor
Source of data	Production reports
Value(s) applied	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.
Purpose of data	Baseline
Additional comment	N/A

Data / Parameter	$\boldsymbol{M_i}$
Unit	Hour

Description	Measuring interval
Source of data	Defined in the technical specifications of data logging system
Value(s) applied	1 hour QA/QC procedures will be applied by regular maintenance of the data logging system.
Purpose of data	Baseline, Project
Additional comment	N/A

Data / Parameter	$OXID_{NMHC}$
Unit	%
Description	Oxidization factor of the hydrocarbon (Non-methane part of the natural gas)
Source of data	AM0028 version03
Value(s) 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
Purpose of data	Project
Additional comment	N/A

Data / Parameter	$OXID_{CH4}$
Unit	%
Description	Oxidization factor of methane (Methane part of the natural gas)
Source of data	AM0028 version03
Value(s) applied	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.
Purpose of data	Project
Additional comment	N/A

Data / Parameter	EF_{RCS}
Unit	tCO_2e/MWh
Description	Emission factor of the electricity for running the DeN_2O unit
Source of data	2000~2004 Statistics of electric power in Korea (The Korea Electrical Power Corporation (KEPCO), http://www.kepco.co.kr)
Value(s) applied	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.
Purpose of data	Project

Additional comment	N/A

D.2. Data and parameters monitored

Data/Parameter	$F_{TI,i}$
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	163,015,272 Nm^3 (total volume from 01/01/2012 to 30/06/2012, from the actual data) Refer to the spread sheet
Monitoring equipment	● Type : Multiple-point sampling tube type flow meter (Maker/Model : Honeywell, STD924-E1H-00000-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, 0712 07030214004 (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 calibrations : Multiple-point sampling tube type flow meter : August 9, 2010 and July 7, 2011 Resistance Temperature Detector : August 9, 2010 and July 15, 2011 Absolute Pressure Transmitter : August 9, 2010 and July 7, 2011 ● Validity : Multiple-point sampling tube type flow meter : November 8, 2011 and October 6, 2012 Resistance Temperature Detector : November 8, 2011 and October 14, 2012 Absolute Pressure Transmitter : November 8, 2011 and October 6, 2012 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	Calibration frequency: refer to the above. Both $\boldsymbol{F}_{\mathbf{TE}}$ and $\boldsymbol{F}_{\mathbf{TI}}$ 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.
Purpose of data	Baseline
Additional comment	N/A

Data/Parameter	$\boldsymbol{CI}_{\mathbf{N2O},i}$
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	3.525415 E-06 tN_2O/Nm^3 (=1,795 ppmv*44/22.4) (average concentration from 01/01/2012 to 30/06/2012, from the actual data) Refer to the spread sheet
Monitoring equipment	• Type : Non-dispersion infrared absorption analyzer. (Maker/Model: ABB/ AO2040/Uras26) • Serial number : 3.346997.7 (Instrument No. 10-AT-061) • Accuracy class : ±0.02% of full scale, according to the supplier's specification • Calibration frequency : QAL2:three years AST:12 months QAL3: every 10 days • Date of last calibrations : QAL2: January 20, 2011 and January 25, 2008 AST: January 18, 2012 and January 19, 2010 QAL3: June 23, 2012 Other QAL3 tests within this monitoring period were conducted every 10 days on average within the validity. • Validity : QAL2: QAL2 on January 25, 2008: valid until January 24, 2011 QAL2 on January 20, 2011: valid until January 19, 2014 AST: valid until January 17, 2013 QAL3: valid until July 3, 2012 QAL2/AST/QAL3 were valid throughout this monitoring period from January 1, 2012 to June 30, 2012. 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	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.
Purpose of data	Baseline
Additional comment	N/A

Data/Parameter	$F_{TE,i}$
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	167,975,214 Nm^3 (total volume from 01/01/2012 to 30/06/2012, from the actual data) Refer to the spread sheet

Monitoring equipment	• 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-00000-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 : 0712 07030214003, 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 calibrations : Multiple-point sampling tube type flow meter : August 9, 2010 and July 7, 2011 Resistance Temperature Detector : August 9, 2010 and July 8, 2011 D/P Transmitter : August 9, 2010 and July 7, 2011 • Validity : Multiple-point sampling tube type flow meter : November 8, 2011 and October 6, 2012 Resistance Temperature Detector : November 8, 2011 and October 7, 2012 Absolute Pressure Transmitter : November 8, 2011 and October 6, 2012 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	Calibration frequency: refer to the above. Both $\boldsymbol{F}_{\mathbf{TE}}$ and $\boldsymbol{F}_{\mathbf{TI}}$ 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.
Purpose of data	Project
Additional comment	N/A

Data/Parameter	$\boldsymbol{CO}_{\mathbf{N2O},\boldsymbol{i}}$

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	4.057487 E-07 tN_2O/Nm^3 (=207 ppmv*44/22.4) (average concentration from 01/01/2012 to 30/06/2012, from the actual data) Refer to the spread sheet
Monitoring equipment	• Type : Non-dispersion infrared absorption analyzer : Maker/Model: ABB/ AO2040/Uras26) • Serial number : 3.346996.7 (Instrument No. 10-AT-062) • Accuracy class : ±0.02% of full scale, according to the supplier's specification • Calibration frequency : QAL2:three years AST:12 months QAL3: every 10 days • Date of last calibrations : QAL2: January 20, 2011 and January 25, 2008 AST: January 17, 2012 and January 19, 2010 QAL3: June 23, 2012 Other QAL3 tests within this monitoring period were conducted every 10 days on average within the validity. • Validity : QAL2: QAL2 on January 25, 2008: valid until January 24, 2011 QAL2 on January 20, 2011: valid until January 19, 2014 AST: valid until January 16, 2013 QAL3:valid until July 3, 2012 QAL2/AST/QAL3 were valid throughout this monitoring period from January 1, 2012 to June 30, 2012. 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/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	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.
Purpose of data	Project
Additional comment	N/A

Data/Parameter	$P_{product,y}$
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	52,013.84$tHNO_3$ (total volume from 01/01/2012 to 30/06/2012, from the actual data) Refer to Annex-2, item-5 of the monitoring report and also the spread sheet
Monitoring equipment	• Type : Magnetic flow meter(Maker/Model : YAMADAKE/MGG14C-BB1A-XCXX-YABJ, Rosemount/Emerson/8705TPA020S1W0N0G3B3Q4) • Serial number : R-98417-41-011, 06011102 (Instrument No. 10-FT-512) • Accuracy class : ±0.5% and ±0.675 % of full scale, according to the supplier's specification • Calibration frequency : 15 months • Date of last calibrations : July 28, 2010 and June 29, 2011 • Validity : October 27, 2011 and September 28, 2012 • Measuring point : At the product line before storage tanks • Measuring range : 0-20 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	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.
Purpose of data	Baseline
Additional comment	N/A

Data/Parameter	T_g
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 : 903.67 °C (June 30, 2012) Minimum temperature : 887.03 °C (January 13, 2012) ** Permitted range : 867.4-905.2 °C Refer to the spread sheet and default data

Monitoring equipment	● 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 calibrations : August 9, 2010 and July 8, 2011 ● Validity : November 8, 2011 and October 7, 2012 ● 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	Hanwha's maintenance and testing regime including calibration based on the vendor requirement.
Purpose of data	Baseline
Additional comment	N/A

Data/Parameter	P_g
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 : 881,025.00 Pa.g (February 15, 2012) = (8.81 *10^5 Pa gauge) Minimum pressure : 720,273.12 Pa.g (March 02, 2012) = (7.20 *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
Monitoring equipment	● Type : Pressure transmitter (Maker/Model : Honeywell/STG 944-E1G-00000-S1) ● Serial number : 0552 05121501006, 0729 07062904012 (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 calibrations : August 9, 2010 and July 7, 2011 ● Validity : November 8, 2011 and October 6, 2012 ● 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 : 0-16 bar gauge
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	Hanwha's maintenance and testing regime including calibration based on the vendor requirement.
Purpose of data	Baseline
Additional comment	N/A

Data/Parameter	G_{sup}
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
Monitoring equipment	N/A
Measuring/Reading/ Recording frequency	During the monitoring period
Calculation method (if applicable)	N/A
QA/QC procedures	Not needed
Purpose of data	Baseline
Additional comment	N/A

Data/Parameter	G_{com}
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.
Monitoring equipment	N/A
Measuring/Reading/ Recording frequency	During the monitoring period
Calculation method (if applicable)	N/A
QA/QC procedures	Not needed
Purpose of data	Baseline
Additional comment	N/A

Data/Parameter	$A_{OR,d}$
Unit	tNH_3/day
Description	Actual ammonia flow rate to the ammonia oxidation reactor
Measured/Calculated /Default	Measured
Source of data	Orifice flow meter and differential pressure transmitter
Value(s) of monitored parameter	Maximum flow rate : 87.85 tNH_3/day (March 14, 2012) Minimum flow rate : 71.21 tNH_3/day (February 13, 2012) ** Permitted range : 88 tNH_3/day maximum Refer to the spread sheet and default data
Monitoring equipment	● 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 : 01210040, 01564836 (Instrument No. 10-FT-502) Resistance Temperature Detector : 07011910, 04014993 (Instrument No. 10-TT-102) Absolute Pressure Transmitter : 01210001, 01624987 (Instrument No. 10- PT-302) ● Accuracy class : according to the supplier's specification Orifice flow meter and differential pressure transmitter: ±0.10% 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 calibrations : Orifice flow meter and differential pressure transmitter: August 9, 2010 and July 7, 2011 Resistance Temperature Detector : August 9, 2010 and July 8, 2011 Absolute Pressure Transmitter: August 9, 2010 and July 7, 2011 ● Validity : Orifice flow meter and differential pressure transmitter: November 8, 2011 and October 6, 2012 Resistance Temperature Detector : November 8, 2011 and October 7, 2012 Absolute Pressure Transmitter : November 8, 2011 and October 6, 2012 ● Measuring point : NH_3 air mixer ● Measuring range : 0-6,000 Nm^3/hr
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	Hanwha's maintenance and testing regime including calibration based on the vendor requirement.
Purpose of data	Baseline
Additional comment	N/A

Data/Parameter	$EI_{RCS,y}$
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	170,844KWh (01/01/2012-30/06/2012) Refer to the spread sheet
Monitoring equipment	• Type : (Maker/Model : LS Industrial System/WL32STE, LD3310CP-005-TES) • Serial number : 0138331, 0297218 • Accuracy class : 2.0 grade, 1.0 grade • Calibration frequency : 15 months • Date of last calibrations : August 10, 2010 and August 23, 2011 • Validity : November 9, 2011 and November 22, 2012 • Measuring point : At the control panel of DeNO2 Unit • Measuring range : 3,000 rev/kWh, 10,000 Pulse/kWh
Measuring/Reading/ Recording frequency	• Measuring frequency : Continuously • Reading frequency : Continuously • Recording frequency : Daily
Calculation method (if applicable)	N/A
QA/QC procedures	Instead of calibration, it is replaced by certified new one before to be finished its validity.
Purpose of data	Leakage
Additional comment	N/A

Data/Parameter	$Q_{NG,y}$
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	89,202.70 Nm^3 (01/01/2012-30/06/2012) Refer to the spread sheet

Monitoring equipment	• Type : Differential pressure transmitter with pressure,/temperature application for compensation(Maker/Model : Honeywell, YSMA125-E1H-00000-1C,CC,F1,MB,MC,S3,(SM)+XXXX, Rosemount/Emerson, 3095MFCCS020N040T32BA1AQ4I5M5) • Serial number : 0712C2932575001001, 02357885 (Insrtument No. 10-FT-563) • Accuracy class : ±1.00809%, ±0.78% of full scale, according to the supplier's specification • Calibration frequency : 15 months, • Date of last calibrations : March 31, 2010 and May 12, 2011 • Validity : June 30, 2011 and August 11, 2012 • 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	Hanwha's maintenance and testing regime including calibration based on the vendor requirement.
Purpose of data	Project
Additional comment	N/A

Data/Parameter	C_{HNC}
Unit	%
Description	Methane content of hydrocarbon (natural gas)
Measured/Calculated /Default	Measured
Source of data	Hydrocarbon supplier
Value(s) of monitored parameter	91.525091 %
Monitoring equipment	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	N/A
Purpose of data	Project
Additional comment	N/A

Data/Parameter	$Q_{NMHC,y}$
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	7,559.85 Nm^3
Monitoring equipment	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	N/A
Purpose of data	Project
Additional comment	N/A

Data/Parameter	$\boldsymbol{Q_{HNC,y}}$
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	81,642.85 Nm^3
Monitoring equipment	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	This parameter is calculated as follows; $Q_{HNC,y} = Q_{NG,y}*C_{HNC}/100$ {89,202.70 * (91.525091/100)}
QA/QC procedures	N/A
Purpose of data	Project
Additional comment	N/A

Data/Parameter	$\boldsymbol{\rho_{NG}}$
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	0.0007965 t/Nm^3
Monitoring equipment	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	N/A

Purpose of data	Project
Additional comment	N/A

Data/Parameter	ρ_{HNC}
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
Monitoring equipment	N/A
Measuring/Reading/ Recording frequency	N/A
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	N/A
Purpose of data	Project
Additional comment	N/A

Data/Parameter	ρ_{NMHC}
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	0.001688642 t/Nm^3
Monitoring equipment	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	This parameter is calculated as follows; $\rho_{NMHC} = (\rho_{NG} - \rho_{HNC} * C_{HNC}/100)/ (1-(C_{HNC}/100)$ (0.0007965 − 0.000714 * 0.91525091) / (1 − 0. 91525091)
QA/QC procedures	N/A
Purpose of data	Project
Additional comment	N/A

Data/Parameter	NCV_{NG}
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	10,404.03 kcal/Nm^3
Monitoring equipment	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	N/A
Purpose of data	Project
Additional comment	N/A

Data/Parameter	EF_{NG}
Unit	tCO_2/tNG
Description	Emission factor of the hydrocarbon
Measured/Calculated /Default	Calculated
Source of data	IPCC 2006 GHG Inventory Guidelines and data provided by the natural gas supplier
Value(s) of monitored parameter	3.067489525 tCO_2/tNG
Monitoring equipment	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 [tCO_2/TJ] 56.1[tCO_2/TJ]by IPCC 2006 GHG Inventory Guidelines (56.1 x 10404.03 x 4.18605/0.0007965 x 10^{-9})
QA/QC procedures	N/A
Purpose of data	Project
Additional comment	N/A

Data/Parameter	EF_{HNC}
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)
Monitoring equipment	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	N/A
Purpose of data	Project
Additional comment	N/A

Data/Parameter	$\boldsymbol{EF}_{\mathbf{NMHC}}$
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	4.51826tCO_2/tNMHC
Monitoring equipment	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	This parameter is calculated as follows; $EF_{NMHC} = (EF_{NG} * \rho_{NG} - EF_{HNC} * \rho_{HNC} * C_{HNC}/100) / (1 - C_{HNC}/100) / \rho_{NMHC}$ ((56.1*10404.03*4.18605/0.0007965/1000000000*0.0007965)-(2.75*0.000714*0.91525091))/(1-0.91525091)/((0.0007965-0.000714*0.91525091)/(1-0.91525091))
QA/QC procedures	N/A
Purpose of data	Project
Additional comment	N/A

Data/Parameter	$\boldsymbol{Type}_{\mathbf{HC}}$
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
Monitoring equipment	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	N/A
QA/QC procedures	N/A
Purpose of data	Project
Additional comment	N/A

Data/Parameter	$\boldsymbol{QR}_{\mathbf{N2O},y}$
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.
Monitoring equipment	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	N/A
QA/QC procedures	N/A
Purpose of data	Baseline
Additional comment	N/A

Data/Parameter	$\boldsymbol{RSE_{N2O,y}}$
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.
Monitoring equipment	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	N/A
QA/QC procedures	N/A
Purpose of data	Baseline
Additional comment	N/A

Data/Parameter	***$CR_{N2O,y}$***
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 monitored 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.
Monitoring equipment	N/A
Measuring/Reading/ Recording frequency	N/A
Calculation method (if applicable)	N/A
QA/QC procedures	N/A
Purpose of data	Baseline
Additional comment	N/A

D.3. Implementation of sampling plan

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N/A

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

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

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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.

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

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.

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

= 177,621.25 tCO_2e

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

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

= 20,657.54 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/Nm³),
$Q_{NMHC,y}$: Hydrocarbon (Non-methane part of the natural gas) input in year y (Nm³),
$OXID_{NMHC}$: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/Nm³),
$Q_{HNC,y}$: Methane (Methane part of the natural gas) used in year y (Nm³)
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 $OXID_{NMHC}$.

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

$= \rho_{NMHC} * Q_{NMHC,y} * EF_{NMHC}$

= 57.68 tCO_2e (non-methane)

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

$= \rho_{HNC} * Q_{HNC,y} * GWP_{CH}$

= 1,224.15tCO_2e (methane)

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

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

$= PE_{ND,y} + HCE_{C,y} + HCE_{NC,y}$

= 20,657.54 + 57.68 + 1,224.15

= 21,939.37 tCO_2e

E.3. Calculation of leakage

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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.

$LE\_y = EI_{RCS,y} * EF_{RCS}$

= 105.92 tCO_2e

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

Time Period	Baseline emissions or baseline net GHG removals by sinks (tCO_2e)	Project emissions or actual net GHG removals by sinks (tCO_{2e})	Leakage (tCO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (tCO_2e)
Total	**177,621.25 tCO_2e**	**21,939.37 tCO_2e**	**105.92 tCO_2e**	**155,575.96 tCO_2e**

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (tCO_2e)	**281,272 tCO_2e/year(365 days)**	**155,575 tCO_2e/year(182 days) equivalent to 312,005 tCO_2e/year(365 days)**

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

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Compared to PDD, value of emission reductions was increased around 10.9% from 281,272 tCO_2e/year (365 days) to 312,005 tCO_2e/year (365 days equivalent).

This is because of the following reasons:

(a) Increase of N_2O content in the tail gas of the nitric acid production process (i.e. Baseline Emission) to average 1,795ppmv during this monitoring period (It is 1,500ppmv in PDD), which is 19.7% higher than PDD value due to the aging/degradation of the primary catalysts in ammonia oxidation reactor and

(b) Increase of the nitric acid production rate during this monitoring period upto 97.5% of the designed capacity of production, which is about 7.5% higher than the expected production of PDD.

History of the document

Version	Date	Nature of revision
02.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01	EB 54, Annex 34 28 May 2010	Initial adoption.
Decision Class: Regulatory **Document Type**: Form **Business Function**: Issuance		

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 01/01/2012 to 30/06/2012, the average value of NOx is 47.94 ppmv the maximum value 142.06 ppmv (on 11/04/2012).

= 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.

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.

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.

5. Production of Nitric Acid

Production volume of Nitric Acid during the project period is 52,013.84tons, which is calculated as

--- 80,021.29 ton x 65/100 = 52,013.84tons

--- 80,021.29 ton is the production mass of HNO_3 which includes H_2O as 35%. Therefore we shall exclude H_2O and come to the pure $HNO_{3\ \text{production volume.}}$ 52,013.84tons

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.

The monitoring period is 182 days from 01/01/2012 to 30/06/2012.

The production volume of Nitric Acid during this period (182 days) is converted to 104,313.47 tons (365 days) where 52,013.84 tons x 365 / 182 as annual basis.

Thus actual production of 104,313.47tons is less than 107,100tons compared as annual basis.

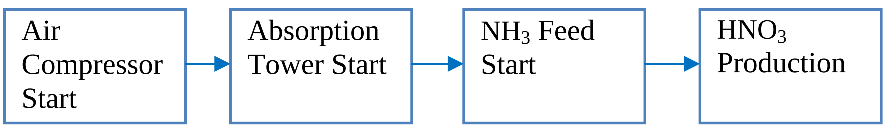
Daily basis production during the period was also within the permitted range, mentioned in the PDD.

Meantime, the operation of Nitric Acid Plant was stopped about 1 days and 4 hours during the following period as below (Time is rounded) :

<Shutdown of the nitric acid plant during this monitoring period>

	Downtime - Start		Downtime - End		Description of downtime reason
	Date	Time	Date	Time	
1	12/03/2012	12	12/03/2012	16	Malfunction of instrument
2	10/04/2012	05	11/04/2012	02	Replacement of primary catalyst

（Remarks）The start-up process of the Nitric Acid Plant operation is as follows in brief.



So, the end time of shutdown is to present the air compressor's start to operate the Nitric Acid Plant.

On the other hand, the operation of DeN_2O unit was stopped about 3 days and 6 hours during the following period as below (Time is rounded):

<Shutdown of DeN_2O unit during this monitoring period>

	Downtime - Start		Downtime - End		Description of downtime reason
	Date	Time	Date	Time	
1	12/03/2012	14	13/03/2012	02	Shutdown of DeN_2O unit due to the malfunction of instrument of the nitric acid plant
2	10/04/2012	04	11/04/2012	09	Shutdown of DeN_2O unit due to the replacement of the primary catalyst of the nitric acid plant
3	16/04/2012	06	17/04/2012	19	Rotary valve trip of DeN_2O unit

6. Shutdown of De N_2O unit

The De N_2O unit was operated well to reduce the N_2O gas from nitric acid plant, except for 3 days and 6 hours including the shutdowns and any abnormal situation of N_2O concentration.

Annex-3 Details of monitoring instrument

Information of monitoring instrument is as below :

(1) AOR instrument

Information of monitoring instrument (2012 / 5th Verification)

No.	Application	Tag No.	Instrument Type	Range	Accuracy	Measuring Frequency	Report Frequency	Year of Manufacture	Information of Instrument	Latest Cal./ Validity	Information of Calibration	Confirmation of Calibration
	AOR Instrument											
1	Actual ammonia input to oxidation reactor (tNH3/day) *)reported in tons	10-FT-502	Differential Pressure Transmitter	0 - 1,600 mmH2O Compensated Flow range 0- 6,000 Nm3/hr	±0.065% of full scale	Continuous	Daily	2007	Manufacturer : Rosemount/Emerson Model No. : 3051CD2A02A1AM5E5S5Q4 Instrument No. : 01210040	Aug 09 / 2010 - Nov 08 / 2011	Interval : 15 months External Entity : Hyupsung HISCO	Dual Installation (10-FT-503)
		10-PT-302	Absolute Pressure Transmitter	0 - 16 bar	±0.065% of full scale	Continuous		2007	Manufacturer : Rosemount/Emerson Model No. : 3051TG3A2B21AB4E5M5Q4 Instrument No. : 01210001	Aug 09 / 2010 - Nov 08 / 2011	Interval : 15 months External Entity : Hyupsung HISCO	Dual Installation (10-PT-303)
		10-TT-102	RTD(Pt 100 ohm) Resistance Temperature Detector	0 - 500 deg C	±0.55 deg C	Continuous		2007	Manufacturer : WISE controls Model No. : R221 Instrument No. : 07011910	Aug 09 / 2010 - Nov 08 / 2011	Interval : 15 months External Entity : Hyupsung HISCO	Dual Installation (10-TT-103)
		10-FT-502	Differential Pressure Transmitter	0 - 1,600 mmH2O 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 07 / 2011 - Oct 06 / 2012	Interval : 15 months External Entity : Hyupsung HISCO	Dual Installation (10-FT-503)
		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 07 / 2011 - Oct 06 / 2012	Interval : 15 months External Entity : Hyupsung HISCO	Dual Installation (10-PT-303)
		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 08 / 2011 - Oct 07 / 2012	Interval : 15 months External Entity : Hyupsung HISCO	Dual Installation (10-TT-103)
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	2007	Manufacturer : YOKOGAWA Model No. : YTA 110 Instrument No. : C2D807670435	Aug 09 / 2010 - Nov 08 / 2011	Interval : 15 months External Entity : Hyupsung HISCO	Dual Installation (10-TT-116)
		10-TT-115	T/C (Type R) Thermocouple ((+)Pt/Rh - (-)Pt)	0 - 1,200 deg C	±1.5 deg C	Continuous	Daily	2007	Manufacturer : YOKOGAWA Model No. : YTA 110 Instrument No. : C2E104013 502	July 08 / 2011 - Oct 07 / 2012	Interval : 15 months External Entity : Hyupsung HISCO	Dual Installation (10-TT-116)
3	Actual operating pressure	10-PT-304	Absolute Pressure Transmitter	0 - 16 bar	±0.065% of full scale	Continuous	Daily	2007	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S1 Instrument No. : 0552 05121501006	Aug 09 / 2010 - Nov 08 / 2011	Interval : 15 months External Entity : Hyupsung HISCO	Dual Installation (10-PT-305)
		10-PT-304	Absolute Pressure Transmitter	0 - 16 bar	±0.065% of full scale	Continuous	Daily	2007	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S2 Instrument No. : 0729 07062904012	July 07 / 2011 - Oct 06 / 2012	Interval : 15 months External Entity : Hyupsung HISCO	Dual Installation (10-PT-305)
4	Ammonia oxidation catalyst	-	Pt/Rh catalyst	Composition 95% Pt, 5% Rh					Manufacturer : Johnsom Matthey	Dec 7 / 2011 (Invoice No. : SD86919) Apr 10 / 2012 (Invoice No. : SD87095)		Commercial invoice of cat. gauzes made available to verify the gauze composition.
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	2004	Manufacturer : YAMATAKE Model No. : MGG14C-BB1A-XCXX-YABJ Instrument No. : R-98417-41-011	Jul 28 / 2010 - Oct 27 / 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	2007	Manufacturer : Rosemount/Emerson Model No. : 8705TPA020S1W0N0G3B3Q4 Instrument No. : 06011102	Jun 29 / 2011 - Sep 28 / 2012	Interval : 15 months External Entity : FM Tech	

(2) AMS instrument

	AMS (Auto Measuring System) Instrument											
1	N_2O concentration at destruction facility inlet	10-AT-061	NDIR N_2O Analyzer	0 - 3,000 ppmv	±0.02% of full scale	Continuous	Hourly	2007	Manufacturer : ABB Model No. : AO2040 / Uras 26 Instrument No. : 3.346997.7	QAL2 Jan 25.2008~Jan 24.2011 Jan 20.2011~Jan 19.2014 AST Jan 19.2010~Jan 18.2011 Jan 17.2012~Jan 16.2013 QAL3 Jun 23.2012~Jul 03.2012 other QAL3 tests within monitoring period were conducted every 10 days	QAL2 three years AST 12 months QAL3 every 10 days	QAL3 interval every 10 days Main work : 1. Zero/Span check by standard gas 2. Leak check 3. Replacement of consummable Gas Chromatography analysis : every 3 months
2	Volume flow of tailgas at N_2O destruction facility inlet	10-FT-561	Differential Pressure Transmitter	0 - 275 mmH$_2$O Compensated Flow range 0- 60,000 Nm3/hr	±0.075% of full scale	Continuous	Hourly	Probe : 2007 Transmitter: 2005	Manufacturer : Honeywell Model No. : STD924-E1H-00000-S2 Instrument No. : 0553 05121501009	Aug 09 / 2010 - Nov 08 / 2011	Interval : 15 months External Entity : Hyupsung HISCO	Confirmation of compensated flow 1. Interval : in 15 months 2. Air Tec(TUV Sud) 3. Compare with standard reference measurement(SRM)
		10-PT-361	Absolute Pressure Transmitter	0 - 16 bar	±0.065% of full scale	Continuous	Hourly	2007	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S1 Instrument No. : 0552 05121501007	Aug 09 / 2010 - Nov 08 / 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		2008	Manufacturer : WISE controls Model No. : R221+ MTM Instrument No. : WS-7M425	Aug 09 / 2010 - Nov 08 / 2011	Interval : 15 months External Entity : Hyupsung HISCO	
		10-FT-561	Differential Pressure Transmitter	0 - 275 mmH$_2$O Compensated Flow range 0- 60,000 Nm3/hr	±0.075% of full scale	Continuous	Hourly	Probe : 2007 Transmitter: 2005	Manufacturer : Honeywell Model No. : STD924-E1H-00000-S2 Instrument No. : 0712 07030214001	July 07 / 2011 - Oct 06 / 2012	Interval : 15 months External Entity : Hyupsung HISCO	Confirmation of compensated flow 1. Interval : in 15 months 2. Air Tec(TUV Sud) 3. Compare with standard reference measurement(SRM)
		10-PT-361	Absolute Pressure Transmitter	0 - 16 bar	±0.065% of full scale	Continuous	Hourly	2007	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S1 Instrument No. : 0712 07030214004	July 07 / 2011 - Oct 06 / 2012	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		2008	Manufacturer : WISE controls Model No. : R221+ MTM Instrument No. : WS-7M139	July 15 / 2011 - Oct 14 / 2012	Interval : 15 months External Entity : Hyupsung HISCO	
3	N_2O concentration at destruction facility outlet	10-AT-062	NDIR N_2O Analyzer	0 - 300 ppmv	±0.02% of full scale	Continuous	Hourly	2007	Manufacturer : ABB Model No. : AO2040 / Uras 26 Instrument No. : 3.346996.7	QAL2 Jan 25,2008~Jan 24,2011 Jan 20,2011~Jan 19,2014 AST Jan 19,2010~Jan 18,2011 Jan 17,2012~Jan 16,2013 QAL3 Dec 26,2010~Jan 05,2011 other QAL3 tests within monitoring period were conducted every 10 days	QAL2 three years AST 12 months QAL3 every 10 days	Maintenance interval every 10 days Main work : 1. Zero/Span check by standard gas 2. Leak check 3. Replacement of consummable Gas Chromatography analysis : every 3 months
4	Volume flow of tailgas at N_2O destruction facility outlet	10-FT-562	Differential Pressure Transmitter	0 - 190 mmH$_2$O Compensated Flow range 0- 60,000 Nm3/hr	±0.075% of full scale	Continuous	Hourly	Probe : 2007 Transmitter: 2005	Manufacturer : Honeywell Model No. : STD924-E1H-00000-S2 Instrument No. : 0553 05121501010	Aug 09 / 2010 - Nov 08 / 2011	Interval : 15 months External Entity : Hyupsung HISCO	Confirmation of compensated flow 1. Interval : in 15 months 2. Air Tec(TUV Sud) 3. Compare with standard reference measurement(SRM)
		10-PT-362	Absolute Pressure Transmitter	- 0.1 - 0.1 bar	±0.065% of full scale	Continuous	Hourly	2007	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S1 Instrument No. : 0712 07030214003	Aug 09 / 2010 - Nov 08 / 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		2008	Manufacturer : WISE controls Model No. : R221+ MTM Instrument No. : WS-7M423	Aug 09 / 2010 - Nov 08 / 2011	Interval : 15 months External Entity : Hyupsung HISCO	
		10-FT-562	Differential Pressure Transmitter	0 - 190 mmH$_2$O Compensated Flow range 0- 60,000 Nm3/hr	±0.075% of full scale	Continuous	Hourly	Probe : 2007 Transmitter: 2005	Manufacturer : Honeywell Model No. : STD924-E1H-00000-S2 Instrument No. : 0712 07030214002	July 07 / 2011 - Oct 06 / 2012	Interval : 15 months External Entity : Hyupsung HISCO	Confirmation of compensated flow 1. Interval : in 15 months 2. Air Tec(TUV Sud) 3. Compare with standard reference measurement(SRM)
		10-PT-362	Absolute Pressure Transmitter	- 0.1 - 0.1 bar	±0.065% of full scale	Continuous	Hourly	2007	Manufacturer : Honeywell Model No. : STG 944-E1G-00000-S1 Instrument No. : 9853 00002001004	July 07 / 2011 - Oct 06 / 2012	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		2008	Manufacturer : WISE controls Model No. : R221+ MTM Instrument No. : WS-7M140	July 08 / 2011 - Oct 07 / 2012	Interval : 15 months External Entity : Hyupsung HISCO	
5	Volume flow of hydrocarbon into the N_2O destruction facility	10-FT-563	Differential Pressure Transmitter with pressure/ temperature applincation for compensation	0 - 2,500 in H_2O Compensated Flow range 0- 100 Nm3/hr	±1.00809% of full scale	Continuous	Hourly	2007	Manufacturer : Honeywell Model No. : YSMA125-E1H-00000-1C,CC,F1, MB,MC,S3,(SM)+XXXX Instrument No. : 0712C2932575001001	Mar 31 / 2010 - Jun 30 / 2011	Interval : 15 months External Entity : FM Tech	Dual measurement (Kyungdong citygas company)
		10-FT-563	Differential Pressure Transmitter with pressure/ temperature applincation for compensation **Pressure, Temperature application for compensation** (Fixed value : 0.45 bar.g, 20 deg C) * Hydrocarbon were supplied as the regulated pressure (0.45 bar.g) and nearly constant temperature by Kyungdong citygas company.	0 - 2,500 in H_2O Compensated Flow range 0- 100 Nm3/hr	±0.78% of full scale	Continuous	Hourly	2011	Manufacturer : Rosemount/Emerson Model No :3095MFCCS020N040T32BA1AQ4I5M5 Instrument No. : 02357885	May 12 / 2011 - Aug 11 / 2012	Interval : 15 months External Entity : Hyupsung HISCO	Dual measurement (Kyungdong citygas company)