

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

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Annex 1 – Table of Equipments/General Information

**MONITORING REPORT
VERSION 1.2 – 04/04/2012****“N₂O EMISSION REDUCTION IN ONSAN, REPUBLIC OF KOREA”
UNFCCC 0099
MONITORING REPORT #58 (from 01/3/2012 to 31/3/2012)****SECTION A. General description of the project activity****A.1. Brief description of the project activity:**

Nitrous oxide (N₂O) is a by-product of adipic acid production. It is of low toxicity but is a greenhouse gas (GHG), whose GWP is large (GWP=310 in the IPCC 2nd Assessment Report). Emissions of N₂O are considered under the Kyoto Protocol and there are no national or regional regulations or restrictions on the emission of N₂O in Korea.

In this project, a thermal decomposition process equipment has been added to the adipic acid manufacturing plant. This installation reduces the GHG emissions, which would otherwise be released to the atmosphere if the project was not implemented.

The thermal decomposition facility was installed and commissioned in the manufacturing site of Onsan Rhodia Poliamide Co. Ltd. during May 2006 and the destruction of N₂O was started in September 2006. The N₂O destruction unit is in continuous operation since its start-up and has only stopped for short periods due to planned and corrective maintenance operations.

In this monitoring period #58 the destruction unit has been operated continuously. The emission reductions achieved in this period are: 951,635 tCO₂e

A.2. Project Participants

KEMCO (Korea Energy Management Corporation)
Rhodia Energy Korea Co, Ltd,
Rhodia Energy SAS, Rhodia Energy GHG SAS
Rhodia Japan Ltd,
ORBEO
NATIXIS, Natixis Environment and Infrastructures,
Société Generale
Noble Carbon Credits

A.3. Location of the project activity:

Host Party: The Republic of Korea
Region: Ulju-gun, Ulsan
City: Onsan
GPS coordinates: 35.412778 129.341667

A.4. Technical description of the project

A thermal oxidizer with 2 chambers is the technology used to decompose N₂O at the Rhodia Onsan site.

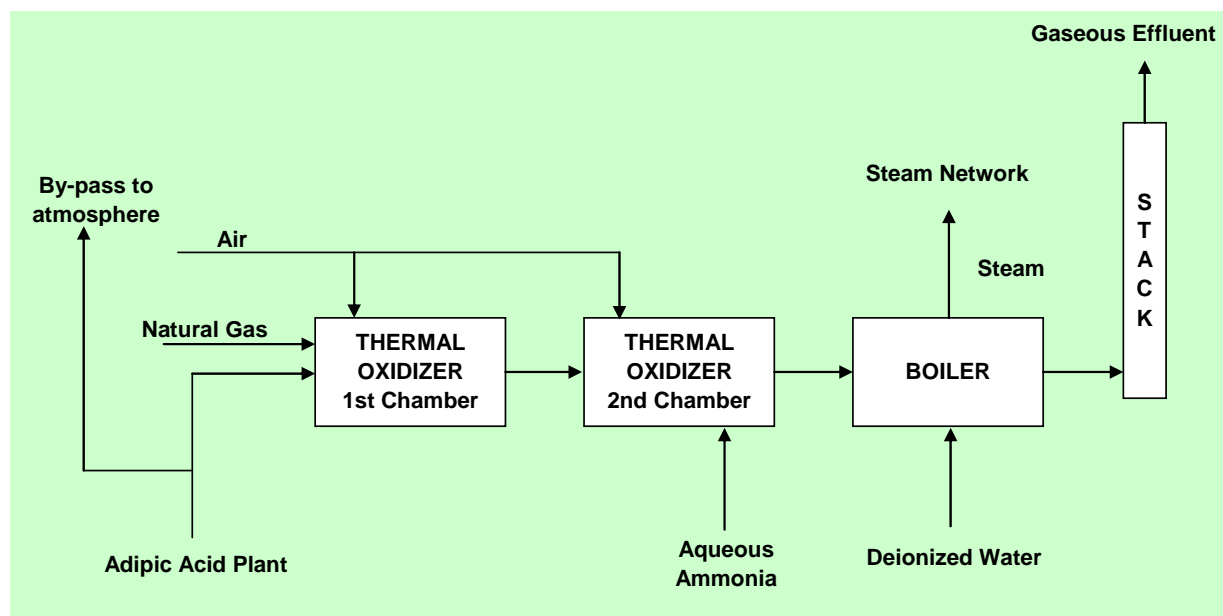
Natural gas is fed with the off gas from the adipic acid production containing N₂O and a controlled amount of air in a reduction chamber, where it burns (oxidizes) to carbon dioxide (CO₂) and water vapour. N₂O is used as an oxidizer. Being oxygen deficient, the oxidation is not complete and carbon monoxide and hydrogen are present.



The temperature in the furnace is kept at about 1300°C and under fuel rich conditions, so as to promote the complete decomposition of N₂O while minimizing the formation of unwanted combustion by-products such as NO and NO₂.

The gas is then quenched with air to complete the combustion of carbon monoxide and hydrogen at a temperature of about 950°C in a second chamber. Steam and ammonia are injected to control the emission of NO and NO₂.

Before release to the stack, the flue gas coming from the thermal oxidizer is used to produce saturated steam, which is fed into the existing on-site steam network.



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

Approved baseline and monitoring methodology:

AM0021/version 1 – “Baseline Methodology for decomposition of N₂O from existing adipic acid production plants”

Referenced Tool(s):

- EB 61 Annex 11 “Tool to determine the mass flow for GHG gaseous streams” version 2, 03/06/2011
- ACM0002/version 2 – “Consolidated methodology for Grid-Connected electricity generation from renewable resources” – Calculation of the CO₂ emission factor of the power generation

Project Design Document:

N₂O Emission Reduction in Onsan, Republic of South Korea.

Version number of the document: 8

Date: 01/09/2005

EB guidance directly related to adipic acid production:

EB45 Annex 13 “Guidance to calculate adipic acid production in cases where it cannot be measured directly” version 1, 13/02/2009

A.6. Registration date of the project activity:

The project was registered by the UNFCCC on 27/11/2005.

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

The first crediting period (on-going) is from 01/09/2006 to 31/08/2013 (renewable).

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

Philippe Kehren, Rhodia Energy GHG
Tour La Pacific. 11, cours Valmy La Defense 7
92977 Paris La Defense, France
TEL : +33 1 53 56 61 02
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**SECTION B. Implementation of the project activity****B.1. Implementation status of the project activity**

The project is fully implemented according to the description presented in the PDD. The project activity is completely operational since the start date of operation on 01/09/2006.

During this monitoring period #58 no particular event occurred that could impact the applicability of the methodology.

In this period the N₂O destruction unit has been fully operational.

B.2. Revision of the monitoring plan

No revision to the monitoring plan has been sought since the beginning of project activity.

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

No request for deviation of the approved methodology was applied to this monitoring period.

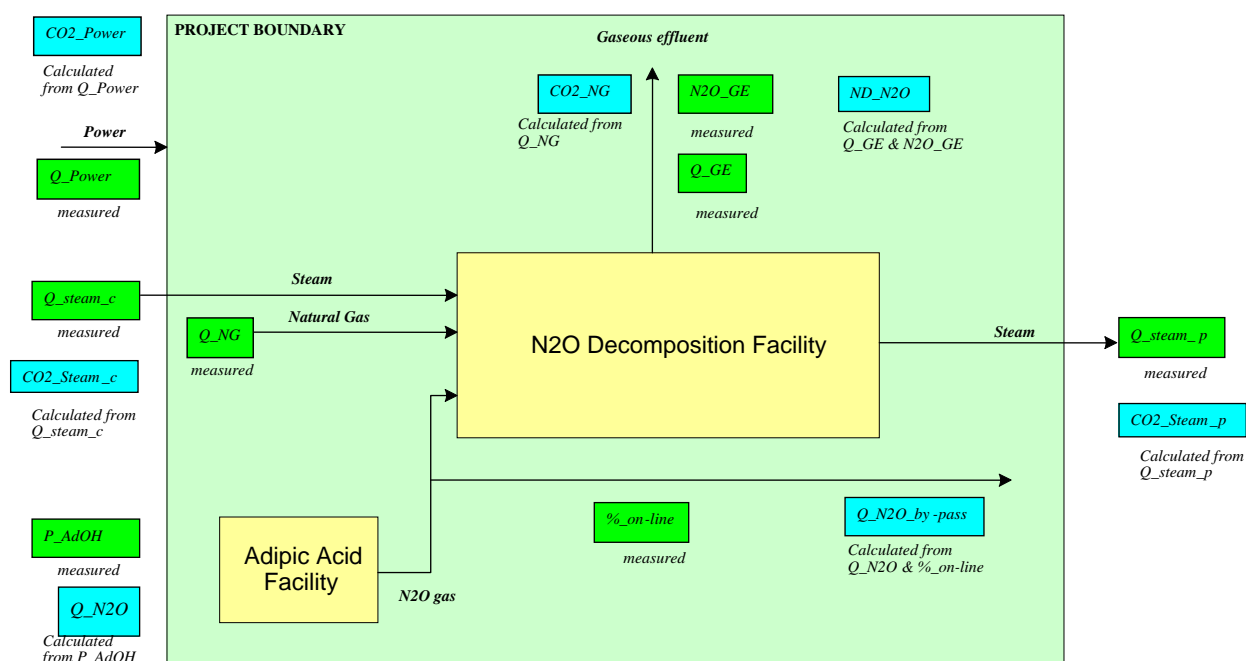
B.4. Notification or request of approval of changes

No changes to the project activity as described in the registered CDM-PDD have been requested.

SECTION C. Description of the monitoring system

The project boundary related to the baseline methodology is shown below with the measured parameters in green color.

Potential sources of anthropogenic emissions by sources of GHG within the project boundary and emissions which are not included in the project boundary are also shown in below and the details of the parameters are informed in the section D.



All data collection procedures, the organizational structure, the roles and responsibilities and procedures for dealing with abnormal situations are described in detail in the Data Handling Protocol and Data Review Protocol which are documents of Rhodia Quality System. Rhodia Onsan plant is ISO9001 and ISO14001 certified.

The Adipic Acid Plant Manager is responsible for implementing and maintaining the monitoring procedures on site (Data Handling Protocol, training, calibration and maintenance, data review) and for validating all data. The overall responsibility of the project belongs to the CO₂ Operations Director of Rhodia Energy GHG located in Paris, France.

All the data used for monitoring the baseline, project and leakage emissions are collected in the PIMS (Plant Information Management System). Two types of data are stored in the PIMS:

- Process data (flow rates, pressures, temperatures etc.) are continuously acquired by the DCS (Distributed Control System) and automatically stored by the PIMS;
- Packed dry adipic acid daily data from log sheets are entered in dedicated excel files (Daily Packaging Reports). These reports are validated by the daily foreman and the supply chain manager before being manually transferred into the PIMS database every working day by the authorized staff.

All measuring instruments used in this project are calibrated and maintained according to the specifications provided by the manufacturers and/or the relevant national and international standards.

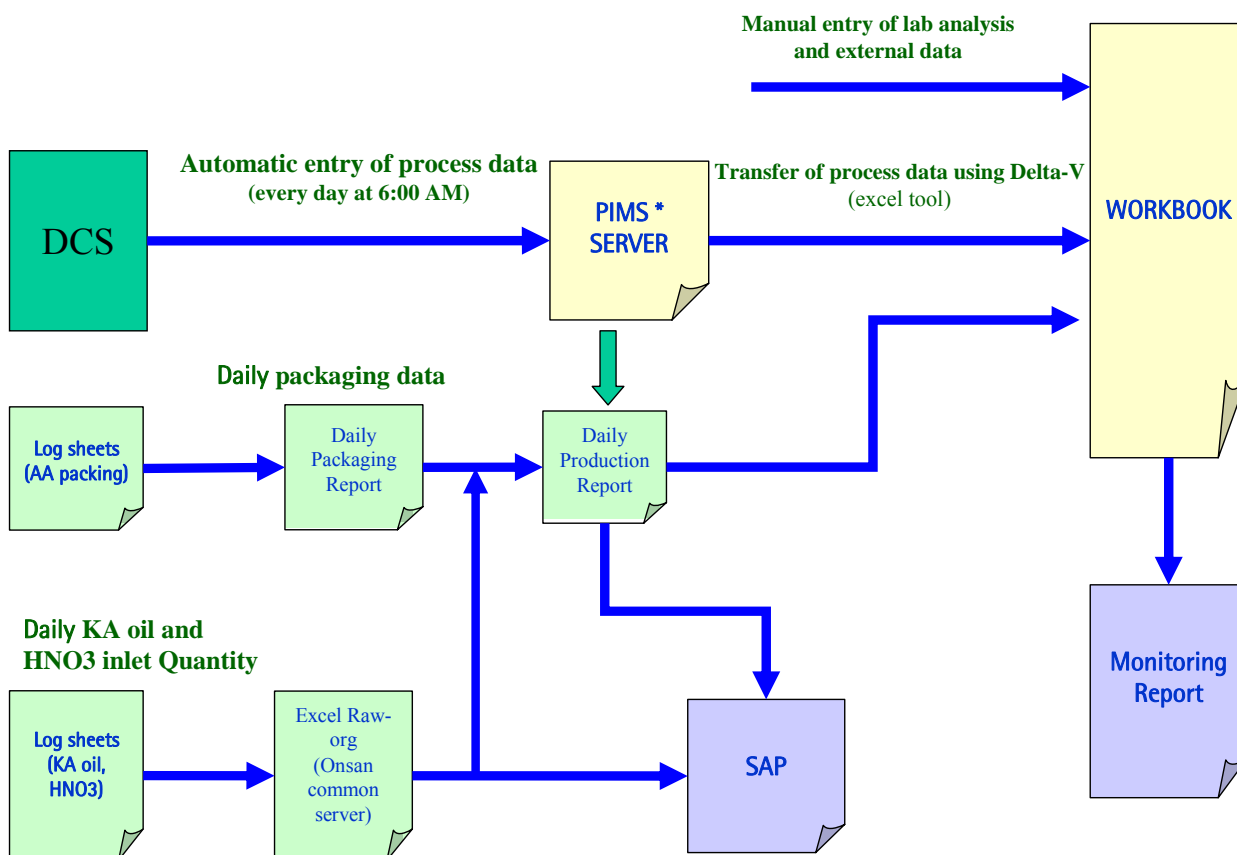
The calculation of the daily production of adipic acid is carried out using the data stored in PIMS and daily packing report, and the daily nitric acid consumption quantity is calculated by using the data stored in PIMS and raw data stored in an excel sheet called Raw-org. The results obtained are collected in a Daily Production Report (excel sheet) and transferred to the Workbook. In parallel the packed quantities are entered in SAP system (System, Applications and Products for Data Processing) which is the official system used by Rhodia for production management, supply chain management and accounting purposes.

The emission reductions calculations are performed in a dedicated excel spreadsheet called the Workbook. Process data are periodically extracted from PIMS using an excel tool called Delta-V and transferred to the Workbook.

The laboratory and some external data such as natural gas composition are entered manually directly into the Workbook (e.g.: natural gas composition).

The calculations made in the Workbook are used for the preparation of the monitoring report.

The following diagram illustrates the entire process of data acquisition, storage and transfer to the Workbook and preparation of the monitoring report:



* PIMS = Plant Information Management System (Supplier: OSI)

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

Data / Parameter:	GWP_N2O
Data unit:	tCO ₂ e per tN ₂ O
Description:	Global Warming Potential of N ₂ O
Source of data used:	Kyoto Protocol (Decision 2/CP.3) and IPCC
Value (s):	310
Data used for:	Baseline and Project Emissions
Additional Comment:	Not applicable

Data / Parameter:	KE_N2O
Data unit:	t N ₂ O per tonne of adipic acid produced
Description:	N ₂ O Emission factor
Source of data used:	IPCC Good Practice Guidance
Value (s):	0.27
Data used for:	Baseline Emissions
Additional Comment:	Cap value for N ₂ O /AdOH emission factor

Data / Parameter:	ΔH
Data unit:	kcal/t of steam
Description:	Enthalpy of vaporization of water
Source of data used:	Steam table for boiler feed water temperature 100°C and 6kg/cm ² steam production
Value (s):	557,960
Data used for:	Baseline Emissions
Additional Comment:	Used to calculate E_Steam

Data / Parameter:	η
Data unit:	%
Description:	Operational efficiency of the boiler for steam production
Source of data used:	Monitoring Plan Section 6.3
Value (s):	97
Data used for:	Baseline Emissions
Additional Comment:	Used to calculate E_Steam

**D.2 Data and parameters monitored**

Data / Parameter:	P_AdOH				
Data unit:	tonnes				
Description:	Amount of adipic acid production				
Measured /Calculated /Default:	Measured value. Several instruments are used				
Source of data:	DCS data and packaging log sheets				
Value(s) of monitored parameter:		From	To	P_AdOH Produced	P_AdOH Eligible *
	Period Value:	01/03/2012	31/03/2012	11,374.532	11,374.532
	Monthly values:	01/03/2012	31/03/2012	11,374.532	11,374.532
	P_AdOH Current year:	79,557			
	P_AdOH Annual Cap:	142,551			
	* Adipic acid production for baseline emission calculation, after cap application				
Data used for:	Baseline and Project Emissions				
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of Last Calibration, validity)	Equipment	Type	Accuracy class	Calibration frequency	Calibration Information
	Small bags and bags balance (W42811) Serial Number: 96C208	Load cell weighing indicator	+/- 0.03 kg	Annually	Last Calibration
					21/04/2011
					Valid Until
					20/04/2012
	Big bags and bags balance (W43741) Serial Number: 2003105	Load cell weighing indicator	+/- 0.3 kg	Annually	Last Calibration
					21/04/2011
					Valid Until
					20/04/2012
	Big bags and bags balance (W43742) Serial Number: 044134	Load cell weighing indicator	+/- 0.3 kg	Annually	Last Calibration
					21/04/2011
					Valid Until
					20/04/2012
	SILO R42500 (W42505) Serial Number: 9009132	Load cell weighing indicator	+/- 3 t	Annually	Last Calibration
					28/02/2012
					Valid Until
27/02/2013					
Measuring/ Reading/ Recording frequency:	Measured daily, aggregated monthly and yearly				



Calculation method (if applicable):	<p>The daily Adipic Acid production is measured directly by the weight of packed finished product and the silo weight difference between two consecutive days. The EB45 guidance Annex 13 in reference does not apply to such cases. The Executive Board has confirmed on EB36 the application of a yearly Adipic acid production cap as required by the methodologies (issue 1 of the Request for review for the Monitoring Period #9 08/08/2007 ~ 31/08/2007).</p> <p>The cumulated production of Adipic acid over the current year (starting last September 1st and ending with the last day of this period) is 79,557 t. This production is below the cap clarified in the EB48.</p> <p>Following EB48 clarification, the cap is 142,551 t/y calculated as $415 \text{ t/d} \times 365 \times 94.109\%$ (information available in the Excel Workbook "ER ONSAN", sheet BE, submitted to UNFCCC). The operational rate is given by the hours of plant operation in 2004 divided by the total hours in 2004. As verified in the monitoring period #26 (see Verification Report No. 1279748 issued on 23 July 2009) the adipic acid plant was operational for 8266.5 hours in 2004 taking out the annual maintenance shut down in November and the other unplanned shutdowns (hours verified with the help of daily data from "Daily AA operation rate 2004" and the daily production reports of 2004). The resulting operational rate is $8266.5/8784 = 94.109\%$.</p> <p>The Executive Board has confirmed on EB36 the application of a yearly Adipic acid production cap as required by the methodology. This approach is consistent with the definitions and requirements of the "Guidance on accounting eligible HFC-23" AM0001 (EB39 Annex 8): the year of the crediting period is defined on the basis of the starting date of the crediting period of a project activity (September 1st); the current period ends on August 31st, which is the end date of the year of the crediting period.</p>
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30

Data / Parameter:	Nitric acid consumption (HNO ₃ _consumption)			
Data unit:	tonnes			
Description:	Nitric acid consumption for the calculation of HNO ₃ chemical			
Measured /Calculated /Default:	Measured Several instruments are used			
Source of data	DCS data and log sheets			
Value(s) of monitored parameter:			HNO ₃ _consumption	
	Rolling Year	31/03/2012	124,560	
	From	To		
	01/03/2012	31/03/2012	10,081	
Data used for:	Baseline and Project Emissions			



Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of Last Calibration, validity)	Equipment	Type	Accuracy class	Calibration frequency	Calibration Information
	Fresh nitric acid HANWHA (FT6C069) Serial Number: 6C069602000	Mass flow meter	+/- 0.65%	Annually	Last Calibration
					04/08/2011
					Valid Until
					03/08/2012
	Fresh nitric acid HANWHA (FT760CD) Serial Number: 760CDF02000	Mass flow meter	+/- 0.65%	Annually	Last Calibration
					17/10/2011
					Valid Until
					16/10/2012
	Fresh nitric acid tank (LT92005) Serial Number: 90A-15477	Flash type level transmitter	+/- 2%	Annually	Last Calibration
					13/04/2011
					Valid Until
					12/04/2012
	Fresh nitric acid tank (LT92015) Serial Number: 12B900530-232	Flash type level transmitter	+/- 2%	Annually	Last Calibration
					13/04/2011
					Valid Until
					12/04/2012
	Truck scale (W90000) Serial Number: '03-07	Load cell weighing indicator	+/- 10 kg	Annually	Last Calibration
					10/09/2011
					Valid Until
09/09/2012					
Measuring/ Reading/ Recording frequency:	Measured continuously, recorded daily. Aggregated monthly and yearly				
Calculation method (if applicable):	The Nitric acid consumption quantity is calculated based on sum of daily fresh HNO3 incoming quantity from Hanwha and Hu-chems, and holding volume and concentration variation of the fresh HNO3 storage tank (R92000 & R92010) and process storage tank (Mother acid tank, concentration acid tank and Oxidation acid tank)				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	Physical losses in the adipic acid production process (HNO ₃ _physical)
Data unit:	tonnes
Description:	Physical losses in the adipic acid production process data required for calculation of HNO ₃ chemical and the N ₂ O emission factor N ₂ O /AdOH
Measured /Calculated /Default:	Measured Several instruments are used
Source of data	DCS data and laboratory analysis data



Value(s) of monitored parameter:			HNO3_physical		
	Rolling Year	31/03/2012	2,948		
	From	To			
	01/03/2012	31/03/2012	212		
Data used for:	Baseline and Project Emissions				
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of Last Calibration, validity)	Equipment	Type	Accuracy class	Calibration frequency	Calibration Information
	Potentiometric Titrator	Potentiometric	0.10%	Weekly	Last Calibration
					26/03/2012
					Valid Until
					Following week
	HPLC	Chromatography	< 0.3% RSD	Daily	Last Calibration
					31/03/2012
					Valid Until
					Following day
	NOx gas DCN inlet (AYA51526) Serial Number: W0625001	NDIR (Non Dispersive Infrared)	+/- 3%	4/year	Last Calibration
					26/03/2012
					Valid Until
					25/06/2012
	LNOX E56010 to A56020 (AYA-56026) Serial Number: W0624984	NDIR (Non Dispersive Infrared)	+/- 5%	4/year	Last Calibration
					26/03/2012
					Valid Until
					25/06/2012
	KAOP to Oxidation (FT12701) Serial Number: 45012E02000	Mass flow meter	+/- 1%	Annually	Last Calibration
					20/02/2012
					Valid Until
					19/02/2013
	LNOX D51500 to E55030 (FQ51525) Serial Number: 91EC29665 551	Orifice type flow transmitter	+/- 5%	Annually	Last Calibration
					02/12/2011
					Valid Until
					01/12/2012
	LNOX D52400 to E56030 (FQ52428) Serial Number: 12B605179-224	Orifice type flow transmitter	+/- 5%	Annually	Last Calibration
					02/12/2011
					Valid Until
01/12/2012					
HPCE R61380 to K83160 (FQ61782) Serial Number: 0870135449	Magnetic Flow Meter	+/- 1%	Annually	Last Calibration	
				20/02/2012	
				Valid Until	
				19/02/2013	



	DBA to F81200 (FQ81115) Serial Number: 0870152709	Magnetic Flow Meter	+/- 1.50%	Annually	Last Calibration
					20/02/2012
					Valid Until
					19/02/2013
	DBA R81100 to K83300 (FQ82351) Serial Number: 91K906367 036	Magnetic Flow Meter	+/- 1%	Annually	Last Calibration
					27/02/2012
					Valid Until
					26/02/2013
	Waste water to R83200 (FQ83401) Serial Number: 26B401923 217	Magnetic Flow Meter	+/- 1%	Annually	Last Calibration
					27/02/2012
					Valid Until
					26/02/2013
Measuring/ Reading/ Recording frequency:	Measured continuously, recorded daily. Aggregated monthly and yearly				
Calculation method (if applicable):	Nitric acid physical losses (HNO3_physical) in the aqueous wastes, the off gases, the adipic acid and the by-product are monitored. Those physical losses are substracted from the nitric acid consumption (HNO3_consumption) to get the chemical consumption.				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	HNO₃_Chemical				
Data unit:	tonnes				
Description:	Chemical consumption of Nitric acid required for the calculation of the N ₂ O emission factor N ₂ O_/AdOH				
Measured /Calculated /Default:	Calculated				
Source of data	Excel Workbook based on the raw material consumption, DCS data and lab data				
Value(s) of monitored parameter:			HNO ₃ _consumption	HNO ₃ _physical	HNO ₃ _chemical
	Rolling Year	31/03/2012	124,560	2,948	121,612
	From	To			
	01/03/2012	31/03/2012	10,081	212	9,869
Data used for:	Baseline and Project Emissions				
Monitoring equipment	Not Applicable				
Measuring/ Reading/ Recording frequency:	Calculated and recorded monthly and yearly				



Calculation method (if applicable):	To obtain the chemical consumption (HNO3_chemical), the physical losses are deducted from the nitric acid consumption. $\text{HNO3_chemical} = \text{HNO3_consumption} - \text{HNO3_physical}$
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30

Data / Parameter:	N2O_/AdOH				
Data unit:	t N2O/t adipic acid				
Description:	Actual N2O emission factor for adipic acid production				
Measured /Calculated /Default:	Calculated				
Source of data:	Not applicable				
Value(s) of monitored parameter:	Period or Month	N2O_/AdOH (Calculated for month/period)	N2O_/AdOH (Calculated for rolling year)	N2O_/AdOH (Applied for baseline emissions)	N2O_/AdOH (Applied for project emissions)
	01/03/2012 31/03/2012	0.291	0.283	0.270	0.291
	The calculation of the by-pass emissions uses the monthly values applied for project emissions. The by-pass emissions for the period are calculated as the sum of the monthly values, and do not use the N2O_/AdOH value of the period, given here for information only.				
	P_AdOH Rolling Year (t)		143,875		
	HNO3_Chemical Rolling Year (t)		121,612		
	N2O_/AdOH capped at		0.270		
Data used for:	Baseline and Project Emissions				
Monitoring equipment	Not applicable				
Measuring/ Reading/ Recording frequency:	Calculated and recorded monthly				



Calculation method (if applicable):	<p>The N₂O emission factor is calculated in two ways:</p> <p>(1) with the month/period values of HNO₃_chemical and P_AdOH</p> <p>(2) using the rolling year cumulated data of HNO₃_chemical and P_AdOH</p> <p>The formula used according to AM0021/version 1 equation (4) is:</p> $N2O_AdOH = HNO3_chemical / P_AdOH / 63 / 2 \times 0.96 \times 44$ <p>For Baseline Emissions, the lowest among the 2 above calculated values and 0.27 is used conservatively, as specified in the PDD table D.2.1.3 and required by the methodology AM0021/version 1 (page 4).</p> <p>To be conservative, the highest value of the three (two calculated values and 0.27) is applied to calculate Q_N₂O_by-pass (see this parameter for details)</p>
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30

Data / Parameter:	Q_N2O				
Data unit:	kg				
Description:	Quantity of N2O produced				
Measured /Calculated /Default:	Calculated value				
Source of data:	Calculated from P_AdOH and N2O_/AdOH data				
Value(s) of monitored parameter:		From	To	Q_N2O	
	Period Value:	01/03/2012	31/03/2012	3,071,123	
	Monthly values:	01/03/2012	31/03/2012	3,071,123	
Data used for:	Baseline Emissions				
Monitoring equipment	Not applicable				
Measuring/ Reading/ Recording frequency:	Calculated and recorded monthly				
Calculation method (if applicable):	Q_N2O = P_AdOH x N2O_/AdOH Only the adipic acid production after cap application is used to define the baseline emission				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	Q_N₂O reg
Data unit:	kg
Description:	Allowed N ₂ O emissions
Measured /Calculated /Default:	Default value
Source of data:	South Korean legislation
Value(s) of monitored parameter:	Not applicable
Data used for:	Baseline Emissions



Monitoring equipment	Not applicable
Measuring/ Reading/ Recording frequency:	At date of the regulatory value introduction or change of the regulation
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	<p>Rhodia follows the evolution of Korean legislation about N₂O emissions that could affect the project Emission Reduction through the parameters N₂O_reg / AdOH, Q_N₂O reg, or ry as part of its RCMS (Rhodia Care Management System), RCMS+ is covering ISO14000 standard which requires to follow any update on Environmental regulations. For the monitoring of the new HSE (Hygiene, Safety and Environment) local and national regulations, Rhodia Korea has joined two committees: "Onsan Environment Management Society" and "Korea Environmental Engineers Federation".</p> <p>The Framework Act on Low Carbon and Green Growth has become effective on 14/04/2010. Within the scope of this Governmental law the list of controlled companies has been announced in September 2010. Designated "controlled" companies have submitted a 3 years historical data on GHG emissions and energy consumption in September 2011. CDM units are excluded from this obligation. There is no applicable limitation from this new regulation on the N₂O emissions of the Onsan Adipic plant.</p>

Data / Parameter:	N₂O reg/AdOH
Data unit:	kg/kg
Description:	Allowed N ₂ O emission / kg of adipic acid produced
Measured /Calculated /Default:	Default value
Source of data:	South Korean legislation
Value(s) of monitored parameter:	Not applicable
Data used for:	Baseline Emissions
Monitoring equipment	Not applicable
Measuring/ Reading/ Recording frequency:	At date of the regulatory value introduction or change of the regulation
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	<p>Rhodia follows the evolution of Korean legislation about N₂O emissions that could affect the project Emission Reduction through the parameters N₂O_reg / AdOH, Q_N₂O reg, or ry as part of its RCMS (Rhodia Care Management System), RCMS+ is covering ISO14000 standard which requires to follow any update on Environmental regulations. For the monitoring of the new HSE (Hygiene, Safety and Environment) local and national regulations, Rhodia Korea has joined two committees: "Onsan Environment Management Society" and "Korea Environmental Engineers Federation".</p>



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Data / Parameter:	r_y
Data unit:	%
Description:	Share of N2O emissions required to be destroyed
Measured /Calculated /Default:	Default value
Source of data:	South Korean legislation
Value(s) of monitored parameter:	Not applicable
Data used for:	Baseline Emissions
Monitoring equipment	Not applicable
Measuring/ Reading/ Recording frequency:	At date of the regulatory value introduction or change of the regulation
Calculation method (if applicable):	Not applicable

QA/QC procedures applied:	<p>Rhodia follows the evolution of Korean legislation about N2O emissions that could affect the project Emission Reduction through the parameters N2O_{reg} / AdOH, Q_{N2O reg}, or r_y as part of its RCMS (Rhodia Care Management System), RCMS+ is covering ISO14000 standard which requires to follow any update on Environmental regulations. For the monitoring of the new HSE (Hygiene, Safety and Environment) local and national regulations, Rhodia Korea has joined two committees: "Onsan Environment Management Society" and "Korea Environmental Engineers Federation".</p>
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Data / Parameter:	P N2O
Data unit:	€/t
Description:	Market price of N2O
Measured /Calculated /Default:	Estimated
Source of data:	Market Survey (last update September 2011)
Value(s) of monitored parameter:	Zero (0) (there is no N2O market for the N2O produced as by-product of adipic acid in Onsan plant)
Data used for:	Baseline Emissions
Monitoring equipment	Not applicable
Measuring/ Reading/ Recording frequency:	Annual up-date based on permanent market survey
Calculation method (if applicable):	Not applicable
QA/QC procedures applied:	Not applicable

Data / Parameter:	Q_Steam_p				
Data unit:	kg				
Description:	Amount of steam produced by the decomposition process				
Measured /Calculated /Default:	Measured				
Source of data:	The data are automatically and continuously acquired by DCS and stored in the PIMS.				
Value(s) of monitored parameter:		From	To	Q_Steam_p	
	Period Value:	01/03/2012	31/03/2012	16,691,770	
	Monthly values:	01/03/2012	31/03/2012	16,691,770	
Data used for:	Baseline Emissions				
Monitoring equipment (type, accuracy class, serial number,	Equipment	Type	Accuracy class	Calibration frequency	Calibration Information
	Steam production	Vortex flow	+/- 1%	Annually	Last Calibration



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calibration frequency, date of Last Calibration, validity)	by N2O system (FIQ58213) Serial Number: 294795/003/01	meter			08/03/2012
					Valid Until
					07/03/2013
	Boiler feed water flow rate (FIQ58204) Serial Number: 294795/002/01	Vortex flowmeter (Back up for FIQ58213)	+/- 0.3%	Annually	Last Calibration
					07/03/2012
					Valid Until
					06/03/2013
	Boiler continuous purge flow rate (FIQ58303) Serial Number: 91L946629 139	Orifice type flowmeter (Back up for FIQ58213)	+/- 0.6%	Annually	Last Calibration
					21/02/2012
					Valid Until
04/03/2013					
Measuring/ Reading/ Recording frequency:	Measured continuously, recorded daily and aggregated monthly				
Calculation method (if applicable):	Not applicable				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

-

Data / Parameter:	E_Steam
Data unit:	kg CO2/kg of steam
Description:	CO2 emission factor of steam produced by facility
Measured /Calculated /Default:	Calculated
Source of data:	Excel workbook
Value(s) of monitored parameter:	0.122
Data used for:	Baseline Emissions
Monitoring equipment	Not applicable
Measuring/ Reading/ Recording frequency:	Not Applicable/each monitoring period
Calculation method (if applicable):	<p>The rolling year value of E_Steam is calculated with the data available for the year prior to the end of the period in order to assure to have the data. The emission factor is obtained by the formula below:</p> $E_Steam = (QNG_tsteam/1,000) * E_NG_y$ $QNG_tsteam = \Delta H \text{ (kcal/t)} / (HHV \text{ (kcal/Nm}^3\text{)} \times \eta \text{ (\%)})$ <p>Where:</p> <p>QNG_tsteam: amount of natural gas required to generate steam (Nm³/t)</p> <p>The HHV data is the yearly average value for the gas supplied by KYUNG DONG City Gas Ltd.</p>



	The yield η (%) of the boiler is conservatively taken as 97%, while the yield is generally below 90% E_NG _y : yearly average value for the gas supplied by KYUNG DONG City Gas Ltd. (kg CO ₂ /Nm ³)				
	Year ending on: 29/02/2012				
	HHV Kcal/Nm ³	ΔH kcal/t	η %	QNG_tsteam Nm ³ /t of steam	E_NG _y kg-CO ₂ /Nm ³
	10,403	557,960	97	55.29	2.206
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	CO2_Steam_p				
Data unit:	t CO ₂ e				
Description:	CO ₂ Emissions from Steam Production				
Measured /Calculated /Default:	Calculated				
Source of data:	Calculated from Q_Steam_p and E_Steam data				
Value(s) of monitored parameter:		From	To	CO ₂ _Steam_p	
	Period Value:	01/03/2012	31/03/2012	2,036	
	Monthly values :	01/03/2012	31/03/2012	2,036	
Data used for :	Baseline Emissions				
Monitoring equipment	Not applicable				
Measuring/ Reading/ Recording frequency :	Calculated Monthly				
Calculation method (if applicable) :	Calculated monthly and expressed in tonnes, using Q_Steam_p and E_Steam CO ₂ _Steam_p = Q_Steam_p x E_Steam				
QA/QC procedures applied :	Data Handling Protocol – RP-Q1-706-30				

Data / Parameter :	Q_GE
Data unit :	Nm ³
Description :	Volume of effluent gas leaving the stack
Measured /Calculated /Default :	Measured
Source of data :	Data are automatically acquired continuously by the DCS and stored in the PIMS data base.



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Value (s) of monitored parameter:		From	To	Q_GE	
	Period Value :	01/03/2012	31/03/2012	13,932,916	
	Monthly values :	01/03/2012	31/03/2012	13,932,916	
Data used for :	Project Emissions				
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of Last Calibration, validity)	Equipment	Type	Accuracy class	Calibration frequency	Calibration Information
	Effluent gas (FIQ58407) Serial Number: 104F-105	Pitot tube differential pressure flow meter	+/- 3%	Annually	Last Calibration
					06/01/2012
					Valid Until
					05/01/2013
Measuring/ Reading/ Recording frequency :	Measured continuously and recorded daily, aggregated monthly				
Calculation method (if applicable) :	Not applicable				
QA/QC procedures applied :	Data Handling Protocol – RP-Q1-706-30				

Data / Parameter :	N2O_GE
Data unit :	vppm
Description :	Concentration of N2O in the effluent gas
Measured /Calculated /Default :	Measured
Source of data :	Data are automatically acquired continuously by the DCS and stored in the PIMS data base.

Value (s) of monitored parameter:		From	To	N2O_GE	
	Period Value:	01/03/2012	31/03/2012	9.6	
	Monthly values:	01/03/2012	31/03/2012	9.6	
Data used for:	Project Emissions				
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of Last Calibration, validity)	Equipment	Type	Accuracy class	Calibration frequency	Calibration Information
	Stack N2O analyzer (AIT58408)	Gas analyzer, type in-situ and laser diode on	+/- 1 vppm	2/year	Last Calibration
					27/02/2012
					Valid Until



Calibration, validity)	Serial Number: 17005	wet basis			26/08/2012
	Stack N2O analyzer (AI58418) Serial Number: W01894257	NDIR (Non Dispersive Infrared)	+/- 1 vppm	weekly	Last Calibration
					30/03/2012
					Valid Until
Following week					
Measuring/ Reading/ Recording frequency:	Measured continuously and recorded daily, aggregated monthly				
Calculation method (if applicable):	The daily average concentration on wet basis is calculated in the DCS as the flow averaged value of concentration values measured every 10 sec: $N2O_GE = \frac{\int (Q_GE \times N2O_GE) \ dt}{Q_GE}$				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	ND_N2O				
Data unit:	kg				
Description:	Quantity of N2O in the effluent gas leaving the stack				
Measured /Calculated /Default:	Calculated				
Source of data:	Data are automatically acquired continuously by the DCS and stored in the PIMS data base.				
Value (s) of monitored parameter:		From	To	ND_N2O	
	Period Value:	01/03/2012	31/03/2012	264	
	Monthly values:	01/03/2012	31/03/2012	264	
Data used for:	Project Emissions				
Monitoring equipment	Not applicable				
Measuring/ Reading/ Recording frequency:	Calculated and recorded daily, aggregated monthly				
Calculation method (if applicable):	<p>The daily value of non destroyed N2O (ND_N2O) is calculated on-line in the DCS using 10 second data of the concentration of N2O and the flow rate of the gaseous effluent, both measured on a wet basis (Equivalent to method C of EB61 “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”):</p> $ND_N2O = Q_GE \times N2O_GE \times \text{Specific_gravity_of_N2O}$ <p>The specific_gravity_of_N2O = 44/22.414 x 10⁻⁶ is used to transform vppm in kg/Nm3</p> <p>When the instant value indicated by AIT58408 is lower than 5 vppm (detection limit), the value of 5 vppm is used in the equation above.</p>				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				



Data / Parameter:	Q_NG				
Data unit:	Nm3				
Description:	Amount of natural gas used by the decomposition process				
Measured /Calculated /Default:	Measured				
Source of data:	Data are automatically acquired continuously by the DCS and stored in the PIMS data base.				
Value (s) of monitored parameter:		From	To	Q_NG	
	Period Value:	01/03/2012	31/03/2012	1,015,658	
	Monthly values:	01/03/2012	31/03/2012	1,015,658	
Data used for:	Project Emissions				
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of Last Calibration, validity)	Equipment	Type	Accuracy class	Calibration frequency	Calibration Information
	Natural Gas burning (FQ91485A) Serial Number: 80067664/2005	Turbine flow meter	+/- 0.3%	Annually	Last Calibration
					20/02/2012
					Valid Until
					19/02/2013
	Natural Gas burning (FQ91485B) (Back up flow meter) Serial Number: 80093966	Turbine flow meter	+/- 0.3%	Annually	Last Calibration
					31/05/2011
					Valid Until
30/05/2012					
Measuring/ Reading/ Recording frequency:	Measured continuous, recorded daily and aggregated monthly				
Calculation method (if applicable):	Not applicable				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	E_NGy
Data unit:	kg CO2/Nm3
Description:	Emissions coefficient for natural gas combustion
Measured /Calculated /Default:	Calculated
Source of data:	Data provided by natural gas supplier (KYUNG DONG City Gas Ltd.)
Value (s) of monitored parameter:	2.206
Data used for:	Project Emissions
Monitoring equipment	Not applicable



Measuring/ Reading/ Recording frequency:	Up-dated at each monitoring period
Calculation method (if applicable):	The emissions coefficient is calculated according to the PDD Monitoring Plan. For the 12 months preceeding the monitoring period, the CO ₂ quantity emitted by the combustion of the natural gas from all the gas boilers is summed up and divided by the total quantity of natural gas consumed in Nm ³ over the same 12 months period. The CO ₂ quantity emitted is obtained by multiplying the emission factor of the month (based on the gas composition of the month) by the quantity of natural gas burned in the same month, using the formulae described in section E1 of the PDD.
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30

Data / Parameter:	NGC				
Data unit:	% vol				
Description:	Natural gas composition required for the calculation of E _{NG}				
Measured /Calculated /Default:	Measured				
Source of data:	Data provided by natural gas supplier (KYUNG DONG City Gas Ltd.)				
Value (s) of monitored parameter:	Component	Number of C	Mar-12		
	CH ₄ (Methane)	1	90.51		
	C ₂ H ₆ (Ethane)	2	5.74		
	C ₃ H ₈ (Propane)	3	2.55		
	I-C ₄ H ₁₀ (I-Butane)	4	0.51		
	N-C ₄ H ₁₀ (N-Butane)	4	0.51		
	I-C ₅ H ₁₂ (I-Pentane)	5	0.02		
	N-C ₅ H ₁₂ (N-Pentane)	5	0.00		
	N ₂ (Nitrogen)	0	0.16		
	CO ₂ (Carbon dioxide)	1	0.00		
	T O T A L		100.00		
	Average number of C		1.138		
	E _{NGm} (kg-CO ₂ /Nm ³)		2.237		
Data used for:	Project Emissions				
Monitoring Equipment	NGC is use to calculate the E _{NG} monthly value. The average number of C in a mole of NG is calculated from the composition = S (number of C in each mole) x (volume ratio). The CO ₂ specific gravity in standard state is 1.965.				



	For this monitoring period, natural gas composition from March 2012 are not yet available, so to be conservative, the NGC of the month of November 2006 was used for March 2012 as it gives the highest E_NG value since the beginning of the crediting period (01/09/2006).
Measuring/ Reading/ Recording frequency:	Recorded monthly
Calculation method (if applicable):	E_NG = 1.965 x (average number of C) 1.965 is the specific gravity of CO2 in standard conditions in kg/Nm3
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30

Data / Parameter:	CO2_NG				
Data unit:	t CO2				
Description:	CO2 Emissions for Natural Gas				
Measured /Calculated /Default:	Calculated				
Source of data:	Calculated in the excel workbook from Q_NG and E_NG data				
Value (s) of monitored parameter:		From	To	CO2_NG	
	Period Value:	01/03/2012	31/03/2012	2,273	
	Monthly values:	01/03/2012	31/03/2012	2,273	
Data used for:	Project Emissions				
Monitoring equipment	Not applicable				
Measuring/ Reading/ Recording frequency:	Calculated Monthly				
Calculation method (if applicable):	CO2_NG is calculated monthly using the monthly values of Q_NG and E_NG $CO2_NG_m = Q_NG_m \times E_NG_m$				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	%_on-line				
Data unit:	% of production time				
Description:	% of production time that the N2O is sent to the decomposition facility.				
Measured /Calculated /Default:	Measured				
Source of data:	Data are automatically acquired continuously by the DCS and stored in the PIMS data base.				
Value (s) of monitored parameter:		From	To	%_on-line	
	Period Value:	01/03/2012	31/03/2012	100.00%	
	Monthly values:	01/03/2012	31/03/2012	100.00%	
Data used for:	Project Emissions				



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	Equipment	Type	Accuracy class	Calibration frequency	Calibration Information
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of Last Calibration, validity)	By-pass valves position detectors (HV57001) Serial Numbers: 603100335	Butterfly type On-off valve	below 1% relative accuracy on %_on-line	Annually	Last Calibration
					08/08/2011
					Valid Until
					07/08/2012
	By-pass valves position detectors (HV57003) Serial Numbers: 603100337	Butterfly type On-off valve	below 1% relative accuracy on %_on-line	Annually	Last Calibration
					26/08/2011
					Valid Until
					25/08/2012
Measuring/ Reading/ Recording frequency:	Measured continuous, recorded daily and aggregated monthly				
Calculation method (if applicable):	The %_on-line is recorded on a daily basis and is the ratio between the time of production of adipic acid while the unit is connected to the N2O destruction facility and the time of production. The opening/closing time of the high integrity by-pass valves is recorded every second in the PI system. At the end of the month/period (y), %_on-line is calculated as: $\%_{\text{on-line}}_y = 1 - (Q_{\text{N2O_by-pass}}_y / (P_{\text{AdOH}}_y \times \text{N2O_AdOH}))$				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	Q_N2O_by-pass				
Data unit:	kg				
Description:	N ₂ O by passing the decomposition facility				
Measured /Calculated /Default:	Calculated				
Source of data:	Data are automatically acquired continuously by the DCS and stored in the PIMS data base.				
Value (s) of monitored parameter:		From	To	Q_N2O_by-pass	N ₂ O_/AdOH Calculated (Actual)
	Period Value:	01/03/2012	31/03/2012	0	0.291
	Monthly values:	01/03/2012	31/03/2012	0	0.291
Data used for:	Project Emissions				
Monitoring equipment	Not applicable				
Measuring/ Reading/ Recording frequency:	Measured continuously, recorded daily and aggregated monthly				
Calculation method (if applicable):	The quantity of N ₂ O that by-pass the facility is calculated daily (d) following AM0021/version1 page 4				



	<p>· $Q_{N_2O_by-pass_d} = Q_{N_2O_d} \times (1 - \%_{on-line})_d$ for each day (d)</p> <p>$Q_{N_2O_d} = P_{AdOH_d} \times N_2O_{/AdOH}$ with $N_2O_{/AdOH}$ is the actual value (considering that it is higher than 0.27) following the final ruling regarding the request for issuance of CERs "N₂O decomposition project of PetroChina Company Limited Liaoyang Petrochemical Company" (EB61)</p> <p>· $Q_{N_2O_by-pass_d} = P_{AdOH_d} \times N_2O_{/AdOH} \times (1 - \%_{on-line})_d$</p> <p>At the end of the period the quantity of N₂O that by-passed the facility is summed for all days:</p> <p>· $Q_{N_2O_by-pass_y} = \Sigma (Q_{N_2O_by-pass_d})$</p>
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30

Data / Parameter:	Q_Power				
Data unit:	kWh				
Description:	Electric consumption of the decomposition facility				
Measured /Calculated /Default:	Measured				
Source of data:	Data are automatically acquired continuously by the DCS and stored in the PIMS data base.				
Value (s) of monitored parameter:		From	To	Q_Power	
	Period Value:	01/03/2012	31/03/2012	109,646	
	Monthly values:	01/03/2012	31/03/2012	109,646	
Data used for:	Leakage				
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of Last Calibration, validity)	Equipment	Type	Accuracy class	Calibration frequency	Calibration Information
	Electricity meter (LV22WH) Serial Number: 0465812	Incremental Electricity meter	+/- 15 kWh	7 years	Last Calibration
					30/01/2012
					Valid Until
					29/01/2019
Measuring/ Reading/ Recording frequency:	Measured continuously, recorded daily and aggregated monthly				
Calculation method (if applicable):	The daily amounts are automatically calculated online on the DCS.				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	E_Power
Data unit:	kg CO ₂ /kWh
Description:	CO ₂ intensity for electric generation



Measured /Calculated /Default:	Calculated
Source of data:	KEPCO data made publicly available by the Korean Energy Economics Institute (KEEI) for 2010
Value (s) of monitored parameter:	0.708
Data used for:	Leakage
Monitoring equipment	Not applicable
Measuring/ Reading/ Recording frequency:	Calculated and up-dated yearly
Calculation method (if applicable):	<p>Calculated using the combined margin (CM) approach according to ACM0002 version 2 in the file (Grid_EF_SouthKorea 2010 rev0.xls). AM00021 version 1 requires calculation of E_Power as “the highest of the operating margin and the build margin according to ACM0002 version 2 for the grid connected to the facility”. The way the emission factor is calculated follows exactly the requirement of the methodology for the following reasons:</p> <p>(i) “according to ACM0002” means among other things to follow the combined margin CM approach (CM is the weighted average of OM and BM, with default weights of 50%/50%),</p> <p>(ii) “the highest of the operating margin” means the simple OM as it is the highest operating margin of all alternatives listed in ACM0002 for calculation of the OM since the simple OM excludes all low-operating costs and must-run power plants which are nuclear power plants, hydro power plants and all renewable energy power plants, and</p> <p>(iii) “the build margin” means the build margin (option 2 updated annually ex post) as required to be calculated following ACM0002 version 2.</p>
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30

Data / Parameter:	CO2_Power
Data unit:	t CO2e
Description:	CO2 Emissions from Electricity consumption
Measured /Calculated /Default:	Calculated
Source of data:	Excel Workbook based on Q_Power and E_Power data

Value(s) of monitored parameter:		From	To	CO2_Power	
	Period Value:	01/03/2012	31/03/2012	78	
	Monthly values:	01/03/2012	31/03/2012	78	
Data used for:	Leakage				



Monitoring equipment	Not applicable
Measuring/ Reading/ Recording frequency:	Calculated monthly
Calculation method (if applicable):	Calculated monthly and expressed in tonnes, using Q_Power and E_Power $CO2_Power = Q_Power \times E_Power$
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30

Data / Parameter:	Q_Steam_c				
Data unit:	kg				
Description:	Amount of steam consumed by the decomposition facility				
Measured /Calculated /Default:	Measured				
Source of data:	Data are automatically acquired continuously by the DCS and stored in the PIMS data base.				
Value (s) of monitored parameter:		From	To	Q_Steam_c	
	Period Value:	01/03/2012	31/03/2012	108,260	
	Monthly values:	01/03/2012	31/03/2012	108,260	
Data used for:	Leakage				
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of Last Calibration, validity)	Equipment	Type	Accuracy class	Calibration frequency	Calibration Information
	Steam import to N2O system (FIQ58082) Serial Number: S5F206714 609	Vortex flow meter	+/- 1.0%	Annually	Last Calibration
					08/03/2012
					Valid Until
					07/03/2013
Measuring/ Reading/ Recording frequency:	Measured continuous, recorded daily and aggregated monthly				
Calculation method (if applicable):	Not applicable				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	E_Steam_c
Data unit:	kg CO2/kg of steam
Description:	CO2 intensity for steam consumed in the facility
Measured /Calculated /Default:	Calculated
Source of data:	Excel Workbook based on natural gas and steam data



Value (s) of monitored parameter:	0.139				
Data used for:	Leakage				
Monitoring equipment	Not applicable				
Measuring/ Reading/ Recording frequency:	Calculated and up-dated at each monitoring period				
Calculation method (if applicable):	<p>The steam consumed in the facility is supplied by existing boilers on site. Steam production and natural gas consumption are continuously monitored. From the monthly natural gas consumption and the monthly value of E_NG, monthly emissions of CO2 for steam production are calculated and cumulated over the year. Q_NG_tsteam in Nm3/t of steam is obtained from the ratio of annual natural gas consumption over the annual steam production.</p> <p>The E_Steam_c is obtained from:</p> $E_Steam_c = E_NG_y \times Q_NG_tsteam$				
	Year ending	Q_NG_tsteam Nm3/t of steam	E_NG kg CO2/Nm3	E_Steam_c kg CO2/kg steam	
	01/03/2012	62.599	2.207	0.139	
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	CO2_Steam_c				
Data unit:	t CO2e				
Description:	CO2 Emissions from Steam consumption				
Measured /Calculated /Default:	Calculated				
Source of data:	Calculated from Q_Steam_c and E_Steam_c				
Value(s) of monitored parameter:		From	To	CO2_Steam_c	
	Period Value:	01/03/2012	31/03/2012	16	
	Monthly values:	01/03/2012	31/03/2012	16	
Data used for:	Leakage				
Monitoring equipment	Not applicable				
Measuring/ Reading/ Recording frequency:	Calculated monthly				
Calculation method (if applicable):	Calculated monthly and expressed in tonnes, using Q_Steam_c and E_Steam_c $CO2_Steam_c = Q_Steam_c \times E_Steam_c$				
QA/QC procedures applied:	Data Handling Protocol - RP-Q1-706-30				

Data / Parameter:	NOx
Data unit:	vppm



Description:	NO + NO2 concentration in the stack gas required by Korean legislation.				
Measured /Calculated /Default:	Measured				
Source of data:	On-line analyser				
Value (s) of monitored parameter:	Parameter	Unit	Limit	Analytical results in this period	
	NOx	vppm	200 max at least 95% of time	Average of 84.5 and less than 200 for 100% of time	
Data used for:	Compliance with local regulation on NOx				
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of Last Calibration, validity)	Equipment	Type	Accuracy class	Calibration frequency	Calibration Information
	Stack NOx analyzer (AT58401) Serial Number: N1- U2- 0176	NDIR (Non Dispersive Infrared)	+/- 1.0%	Weekly	Last Calibration
					30/03/2012
					Valid Until
					06/04/2012
Measuring/ Reading/ Recording frequency:	Continuous/Daily and monthly According to local government environmental law, NOx value is transmitted to local government agency as a part of the TeleMonitoring System (TMS) from 01/07/2007.				
Calculation method (if applicable):	Not applicable				
QA/QC procedures applied:	To make sure of the on-line analysis value, KumHo Environmental Co, Ltd had carried out the analysis of the gas discharged from the N2O stack during this monitoring period. The analysis values were under the control specification limit of the Korea environmental regulation (KumHo Company has an analysis license for air emission which is permitted by the Korean environmental government) Data Handling Protocol - RP-Q1-706-30				

For other additional informations about the equipments cited above consult the Annex 1.

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

The amount of baseline emissions in the given period y is calculated using the following formula according to AM0021/version 1 equation (1):

$$BE_y = Q_{N_2O_y} \times GWP_{N_2O} + Q_{Steam_p_y} \times E_{Steam_y}$$

It has been checked that there are no South Korean regulation in place that would limit the quantity of N_2O emitted that can be taken into account for the calculation of the baseline emissions (see D.2.1.4. in the PDD).

The quantity $Q_{N_2O_y}$ of N_2O emitted over the period can then be calculated by:

$$Q_{N_2O_y} = P_{AdOH_y} \times N_2O_{/AdOH}$$

Over the period of reference the emission factor of the adipic acid plant was above the capped value of 0.27 kg N_2O /kg AdOH. So the capped value is being used according to AM 0021/version 1. The baseline emissions in this monitoring period are calculated in the table below using the values detailed in section D.2 above:

Parameter	Value	Unit
$Q_{N_2O_y}$	3,071,123	kg
P_{AdOH_y} (eligible)	11,374.532	t
$N_2O_{/AdOH}$	0.270	kg N_2O /kg AdOH
$Q_{N_2O_reg}$	No limit	
$N_2O_{_reg} / AdOH$	No limit	
r_y	NA	
$GWP_{N_2O} (1)$	310	kgCO ₂ e/kg N_2O
$Q_{Steam_p_y}$	16,691,770	kg of Steam
E_{Steam_y}	0.122	kg CO ₂ /kg of Steam
BE_y	954,084	tCO₂e

(1) Kyoto Protocol Rule, Decision 2/CP.3 and IPCC

By manual calculation of BE_y the result may differ slightly from the more accurate value of the workbook shown above due to rounding down effects applied to remain conservative.

E.2. Project emissions calculation

According to AM0021, version 1, the project emissions PE_y are the emissions in the period y due to:

- the N_2O that has not been sent to the decomposition process (i.e. the N_2O that by-passed the decomposition facility)
- the N_2O non-destroyed by the decomposition process
- the emissions due to the use of natural gas.

PE_y is calculated as follows:

$$PE_y = (Q_{N_2O_by-pass_y} + ND_{N_2O_y}) \times GWP_{N_2O} + Q_{NG_y} \times E_{NG_y} \text{ (AM0021/version 1 equation (5))}$$

With $CO_2_{NG} = Q_{NG} \times E_{NG}$ (PDD section E.1) we get:

$$PE_y = (Q_{N_2O_by-pass_y} + ND_{N_2O_y}) \times GWP_{N_2O} + CO_2_{NG_y}, \text{ where:}$$

$$Q_{N_2O_by-pass_y} = P_{AdOH_y} \times (1 - \%_{on-line_y}) \times N_2O_{AdOH_y}$$

As a conservative interpretation of the methodology $Q_{N_2O_by-pass_y}$ is calculated using the actual value of $N_2O_{AdOH_y}$

$$ND_{N_2O_y} = Q_{GE_y} \times N_2O_{GE_y} \times \text{Specific gravity of } N_2O \times 10^{-6}$$

The project emissions in this monitoring period are calculated in the table below using the values presented in detail in section D:

Parameter	Value	Unit
P_{AdOH_y}	11,374.532	t
$N_2O_{AdOH_y}$	0.291	kg N_2O /kg AdOH
$\%_{on-line_y}$	100.00	%
$Q_{N_2O_by-pass_y}$	0	kg
Q_{GE_y}	13,932,916	Nm ³
$N_2O_{GE_y}$	9.6	vppm
Specific gravity of N_2O	1.963	kg/Nm ³
$ND_{N_2O_y}$	264	kg N_2O
$GWP_{N_2O} (1)$	310	kgCO ₂ e/kg N_2O
$CO_2_{NG_y}$	2,273	tCO ₂ e
PE_y	2,355	tCO ₂ e

(1) Kyoto Protocol Rule, Decision 2/CP.3 and IPCC

$Q_{N_2O_by-pass}$ and ND_{N_2O} in kg need to be divided by 1,000 to get PE in t CO₂e

By manual calculation of PE_y the result may differ slightly from the more accurate value of the workbook shown above due to rounding up effects to remain conservative.

E.3. Leakage calculation

Leakage emissions in a given period y comprise the emissions associated with the energy sources used to generate any steam and electricity used by the decomposition plant.

Leakage is calculated according to AM0021/version 1, equation (7):

$$L_y = Q_{\text{Power}_y} \times E_{\text{Power}} + Q_{\text{steam}_y} \times E_{\text{steam}_y}$$

The leakage emissions in this monitoring period are calculated in the table below using the values presented in the detail in section D:

Parameter	Value	Unit
Q_{Power_y}	109,646	kWh
E_{Power}	0.708	kg CO ₂ /kWh
Q_{Steam_y}	108,260	kg
E_{Steam_y}	0.139	kg CO ₂ /kg of steam
L_y	94	tCO ₂ e

By manual calculation of L_y the result may differ slightly from the more accurate value of the workbook shown above due to rounding up effects to remain conservative.

E.4. Emission reductions calculation / table

Following the methodology AM0021/version 1 and the PDD section D.2.4, the total emission reductions achieved by this project activity during this monitoring period is:

$$ER_y = BE_y - PE_y - L_y$$

Thus:

$$ER_y = (954,084 - 2,355 - 94) \text{ tCO}_2\text{e}$$

$$ER_y = 951,635 \text{ tCO}_2\text{e}$$

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

In the PDD section E the emission reduction is estimated to be 9,147,301 tCO₂e. So the PDD-estimated emission reduction relative to the monitoring period of 31 days is 776,894 tCO₂e lower than the emission reductions of the current monitoring period.

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
BE _v (tCO ₂ e)	925,650	954,084
PE _v (tCO ₂ e)	148,557	2,355
L _v (tCO ₂ e)	199	94
Emission reductions (tCO₂e)	776,894	951,635

E.6. Remarks on difference from estimated value

For the sake of clarity, the amount of Emission Reductions can exceed the amount calculated in a year period in the PDD as all data in the PDD were conservative, in particular the performance of the N₂O abatement unit (in fact, the actual efficiency has been > 85%, and the destruction rate > 99%).

BE:	
PDD value (tCO₂e): 925,650	Period (tCO₂e): 954,084
Variance	Explanation
27,908	The adipic acid production used for the ex-ante emission reduction was conservatively taken as 130,000 t/y (356.2 t/d) which is lower than the nameplate capacity of 151 475 t/y (415 t/d x 365) mentioned in the PDD. When a capacity investment is made, there are design margins (10 to 20%) taken by engineering. During this period the average production quantity is 367t/d on average during this period to meet the low market demand.
526	Slight impact of the steam production
28,434	Total BE variance

It is important to note that according to the methodology AM0021/version 1, the eligible adipic acid production that can be used in the baseline is yearly capped, so it limits on a yearly basis the emission reduction calculation claimed for CERs. Please refer to item E.1 for details.



PE:	
PDD value (tCO₂e): 148,557	Period (tCO₂e): 2,355
Variance	Explanation
138,621	<p>The significant higher performance of the N₂O abatement unit (the actual % online of 1.00% in this period is significantly higher than the value of 85% estimated in the PDD due to excellent operational performance).</p> <p>The estimate of 85% in the PDD assumed a low performance rate of the destruction equipment due to the lack of experience with such equipment.</p>
7,817	A higher destruction rate of the N ₂ O which is in excess of 99.99 % during this period versus 99 % taken conservatively in the PDD.
-235	Difference in the natural gas consumption estimate and actual in the period
146,202	Total PE variance

L	
PDD value (tCO₂e): 199	Period (tCO₂e): 94
Variance	Explanation
105	Difference mainly due to the quantity of steam consumed
105	Total L variance

The actual emission reductions determined in this monitoring period are higher than the *pro rata* estimation based on the *ex-ante* calculation made in the PDD, as explained above. This is to be expected because, given the general experiences with constant overestimation of CER volumes in the first years of CDM project development, Rhodia wanted to set the CER estimates in the PDD in a conservative fashion, especially regarding performance of the abatement equipment

Annex 1. Table of Equipments/General Information

Related PDD parameter	Instrument Location	Tag number	Periodicity	Reference for calibration frequency	Done by	Previous calibration date	Last calibration date
%_online	By-pass Valves Integrity Check	HV-57001	Annually	Section D.3 of PDD	Rhodia	08/03/2011	08/08/2011
%_online	By-pass Valves Integrity Check	HV-57003	Annually	Section D.3 of PDD	Rhodia	08/03/2011	26/08/2011
P_AdOH	Small bags and bags Balance	W42811	Annually	- Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:287)	Third party	28/04/2010	21/04/2011
P_AdOH	Big bags and bags Balance	W43741	Annually	- Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:287)	Third party	28/04/2010	21/04/2011
P_AdOH	Big bags and bags Balance	W43742	Annually	- Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:287)	Third party	28/04/2010	21/04/2011
Q_steam_c	Steam import to N2O system	FIQ-58082	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:296)	Third party	25/03/2011	08/03/2012
Q_steam_p	Steam production by N2O system	FIQ-58213	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:296)	Third party	25/03/2011	08/03/2012
Q_steam_P	Boiler feed water to N2O system	FIQ58204	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:295)	Third party	24/03/2011	07/03/2012
Q_steam_p	Boiler continuous purge flow rate	FIQ58303	Annually	Standards rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:292)	Rhodia	15/03/2011	21/02/2012
N2O_GE	Stack N2O analyzer (in-situ, laser diode)	AI58408	2 / year	Section 5.3 of the LaserGas II SP Monitor, User's reference v.1.2 from vender (page : 45)	Rhodia	06/09/2011	27/02/2012
N2O_GE	Stack N2O analyzer (extractive infrared)	AI58418	Weekly	Section 7.2 of instruction manual (90002929, 07/2005) from vender	Rhodia	24/02/2012 02/03/2012 09/03/2012 16/03/2012 23/03/2012	30/03/2012
Q_NG	Natural Gas burning	FQ91485A	Annually	Standards rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:296)	Third party	09/03/2011	20/02/2012
Q_NG	Natural Gas burning (Back up flow meter)	FQ91485B	Annually	Standards rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:296)	Third party	29/09/2010	31/05/2011
Q_GE	Effluent Gas	FIQ-58407	Annually	- National Environmental regulation	Third party	28/02/2011	06/01/2012
Q_Power	Electricity meter	LV22WH	Every 7 years	Table 13 of the Korean law on electricity measurement	Third party	21/10/2008	30/01/2012



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Related PDD parameter	Instrument Location	Tag number	Periodicity	Reference for calibration frequency	Done by	Previous calibration date	Last calibration date
Nitric physical	Potentiometric titrator	Lab analyzer	weekly	Calibration frequency by vendor recommendation	Rhodia	20/02/2012 27/02/2012 05/03/2012 12/03/2012 19/03/2012	26/03/2012
Nitric physical	HPLC	Lab analyzer	Daily	Calibration frequency by vendor recommendation	Rhodia	Daily	31/03/2012
Nitric Cons	Truck Scale	W-90000	Annually	- Article 32 of the Korean law on weighing - Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:287)	Third party	11/09/2010	10/09/2011
Nitric Cons	FRESH NITRIC ACID HANWHA	FT6C069	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:295)	Third party	16/09/2010	04/08/2011
Nitric Cons	FRESH NITRIC ACID HANWHA	FT760CD	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:295)	Third party	21/10/2010	17/10/2011
Nitric Cons	FRESH NITRIC ACID TANK R92000	LT-92005	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:292)	Rhodia	16/04/2010	13/04/2011
Nitric Cons	FRESH NITRIC ACID TANK R92010	LT-92015	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:292)	Rhodia	16/04/2010	13/04/2011
Nitric physical	NOX GAS DCN INLET	AYA-51526	4 / year	Section 4.2 of the reference book of Instructions 015-556383-K from Beckman Industrial.	Rhodia	16/02/2012 12/03/2012	26/03/2012
Nitric physical	LNOX E56010 TO A56020	AYA-56026	4 / year	Section 4.2 of the reference book of Instructions 015-556383-K from Beckman Industrial.	Rhodia	16/02/2012 12/03/2012	26/03/2012
Nitric physical	KAOP TO OXIDATION	FT-12701	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:295)	Third party	08/03/2011	20/02/2012
Nitric physical	LNOX D51500 TO E55030	FQ-51525	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:292)	Rhodia	06/12/2010	02/12/2011
Nitric physical	LNOX D52400 TO E56030	FQ-52428	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:292)	Rhodia	06/12/2010	02/12/2011
Nitric physical	HPCE R61380 TO K83160	FQ-61782	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:295)	Third party	08/03/2011 19/09/2011	20/02/2012
Nitric physical	DBA TO F81200	FQ-81115	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:295)	Third party	08/03/2011	20/02/2012
Nitric physical	DBA R81100 TO K83300	FQ-82351	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:295)	Third party	10/03/2011	27/02/2012
Nitric physical	Waste water to R83200	FQ-83401	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:295)	Third party	08/03/2011	27/02/2012
Reference	KA OIL TANK R92100	LT-92106	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:292)	Rhodia	13/05/2010	06/05/2011
Reference	KA OIL TANK R92200	LT-92206	Annually	Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:292)	Rhodia	13/05/2010	06/05/2011
P_AdOH	SILO R42500	W-42505	Annually	- Standard rule of calibration & maintenance guide book from Korea association of standards & testing organization (Page:287)	Rhodia	22/08/2011	28/02/2012
Not in the PDD	NOx N2O unit stack	AT58401	Weekly	Section 3.6 of instruction manual (C79000-G5276-C143-07) from vender(Environnement management corporation)	Rhodia	24/02/2012 02/03/2012 09/03/2012 16/03/2012 23/03/2012	30/03/2012