



**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)**

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**SECTION A. General description of project activity****A.1 Title of the project activity:**

Nanjing Chemical Industries Co Ltd (NCIC) Nitrous Oxide Abatement Project

A.2. Description of the project activity:

The objective of this project is to eliminate approximately 90% of the Nitrous Oxide (N₂O) emissions occurring at Nanjing Chemical Industries Co., Ltd's (hereafter refer to as "NCIC") facility in Nanjing, P.R. China. N₂O is produced as a side reaction in the production of nitric acid. Through catalysis, N₂O will be converted into nitrogen (N₂) and oxygen (O₂) gases which will be released harmlessly to the environment.

This project is not only important because of the reduction in N₂O emissions that will be achieved, but because its implementation will improve industrial environmental performance and introduce new state-of-the-art technology into commercial use in China. Achieving both of these goals will be an important step in meeting objectives set by the Chinese government. In addition, the project will contribute to sustainable development in China in several ways.

First, a portion of revenues from this project will be invested in a community-based project that will improve the lives of local people in a sustainable fashion. Projects may include infrastructure improvements, upgrading of educational facilities, or additional pollution control measures including, but not limited to, further Green House Gas (GHG) initiatives to enhance energy conservation or the use of biomass, etc. Second, this project will demonstrate the commercial viability of N₂O abatement creating a greater likelihood that control technology will be used at other commercial facilities in China to abate N₂O emissions. This will provide even further environmental and economic benefits. Third, NCIC will receive income from this project which can be used in part to invest in additional environmental improvements at the Nanjing facility. Finally, local employment will be created during the engineering design and catalyst installation phases of this project.

A.3. Project participants:

The parties involved in the project activities will be the Project Sponsor Nanjing Chemical Industries Co Ltd, in whose plant the catalyst will be installed, Carbonventures who will act as an Project Applicant, Project Advisor and Developer to the Project Sponsor and BASF who will be the Technology Provider.

(1) Project Applicant, Advisor and Developer

Carbon Ventures Limited, a privately owned subsidiary of ENVIRON Holdings Inc

Carbon Ventures Limited and BASF have an exclusive agreement to develop and implement nitrous oxide abatement projects at fertiliser and chemical plants worldwide.

Carbon Ventures Limited, a private company incorporated in the United Kingdom, provides a full range of greenhouse gas management services to clients, including the development and implementation of Clean Development Mechanism and Joint Implementation projects worldwide. Carbon Ventures is a subsidiary of ENVIRON Holdings Inc.

ENVIRON Holdings Inc (ENVIRON) is a global technical and scientific consultancy providing state-of-the-art scientific, engineering, and strategic risk management assistance to an international client base. ENVIRON staff consist of over 600 professionals in more than 40 offices in the U.S, U.K, Europe, and Asia-Pacific, with experience and expertise in a wide variety of disciplines, including life sciences,



engineering, geosciences, public health, and regulatory affairs. ENVIRON has two offices in China, one in Shanghai and the other in Beijing.

(2) Project Sponsor

Nanjing Chemical Industries Co Ltd (Sinopec), a subsidiary of China Petroleum And Chemical Corporation

NCIC, a subsidiary company of China Petroleum And Chemical Corporation (Sinopec) is a large chemical industrial enterprise. It is engaged in the production and distribution of fertilizer, inorganic industrial chemicals, organic industrial chemicals, catalyst, chemical machinery and chemical fibre, with a total of six series and more than two hundred products. In addition, NCIC also conducts research, design, manufacturing, construction and installation of chemical industry.

Sinopec is a publicly listed company whose core business is petroleum and petrochemicals. Sinopec is a vertically integrated energy and chemical company and is China's second largest oil producer and China's largest supplier of oil products.

The company was set up on 28 February 2000, pursuant to the Company Law of the Peoples Republic of China and in line with the principle of "separation" of core business from the ancillary, good assets from the bad, and enterprise functions from the "social". Sinopec's operations range from exploration, development, production, and marketing of petroleum to natural gas refining and marketing, production and sale of petrochemicals, chemical fibers, and chemical fertilizers.

(3) Technology Provider

BASF A.G. a publicly-owned company

BASF of Germany is the world's leading chemical company, offering its customers a range of high-performance products, including chemicals, plastics, coatings systems, dispersions, agricultural products, and fine chemicals as well as crude oil and natural gas. BASF is an industry leader in sustainable development including environmental protection, safety and health, and social responsibility. BASF had 2001 sales of \$29 billion and employs more than 90,000 people worldwide. BASF shares are traded on the stock exchanges in New York (BF), Frankfurt (BAS), London (BFA), Paris (BA), and Zurich (BAS). In response to climate change BASF have developed an patented secondary catalyst for use in destroying N₂O generated in the production of nitric acid. This secondary catalyst has operated successfully in several plants for the past 5 years.

Potential Project CER Buyers are:

- The World Bank Prototype Carbon fund.
- Mitsui
- Climate Change Capital
- ICECAP

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

Nanjing in China

**A.4.1.1. Host Party(ies):**

Peoples Republic of China

A.4.1.2. Region/State/Province etc.:

Dachang District China

A.4.1.3. City/Town/Community etc:

Nanjing

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

NCIC , Nanjing: Nanjing was the former capital of China and is located about 4 hours drive inland from Shanghai.





A.4.2. Category(ies) of project activity:

This project belongs to category 5: Chemical Industries listed in the Sectoral Scopes for accreditation of the operational entities.

A.4.3. Technology to be employed by the project activity:

Nitrous Oxide (N_2O), a by-product gas produced in the manufacture of nitric acid, has a high Global Warming Potential (GWP) of 310. The N_2O concentration in the off gas emitted by a nitric acid plant is equivalent to 1,200ppmv. This represents close to 60% of the Greenhouse Gas equivalent emissions of a nitric acid plant. The N_2O passes through the entire process as an inert gas and is emitted in the plant off gas to the atmosphere. N_2O is not destroyed in the DeNox reactors typically installed in the flue gas. N_2O is a persistent and stable gas.

The concentration of N_2O can be reduced by approximately 90% utilizing technology that destroys the N_2O converting it into Oxygen (O_2) and Nitrogen (N_2) which have zero GWPs. In the proposed project, a catalyst will be installed directly under the platinum gauze in the NH_3 Burner basket. N_2O monitoring and recording facilities will be installed to continually measure the amount of N_2O destroyed.

Current Situation

The possible ways of lowering N_2O emissions at nitric acid plants can be categorized into three groups:

- **Primary:** N_2O is prevented from forming. This requires modifications to the precious metal ammonia oxidation gauzes to reduce N_2O formation. Alternative materials can also be employed as the ammonia oxidation catalyst. Cobalt oxide, for example, does not generate any N_2O byproduct, but suffers from being less selective for the production of N_2O .
- **Secondary:** N_2O , once formed, is removed anywhere between the outlet of the ammonia oxidation gauzes and the inlet of the absorption tower. The preferred position of choice for secondary methods is directly after the gauzes located in the reactor basket.
- **Tertiary:** N_2O is removed from the tail gas downstream of the absorption tower by catalytic destruction (either by catalytic decomposition or by catalytic reduction). In general the optimum position for a tertiary N_2O destruction facility is at the hottest position in the tail gas stream. In tertiary catalytic N_2O destruction processes a hydrocarbon input may be necessary to achieve the highest available N_2O destruction rate. Thus hydrocarbons may be used to increase the tail gas temperature for catalytic decomposition processes (indirect emissions) or as a reducing agent in



catalytic reduction processes of N_2O (direct emissions).

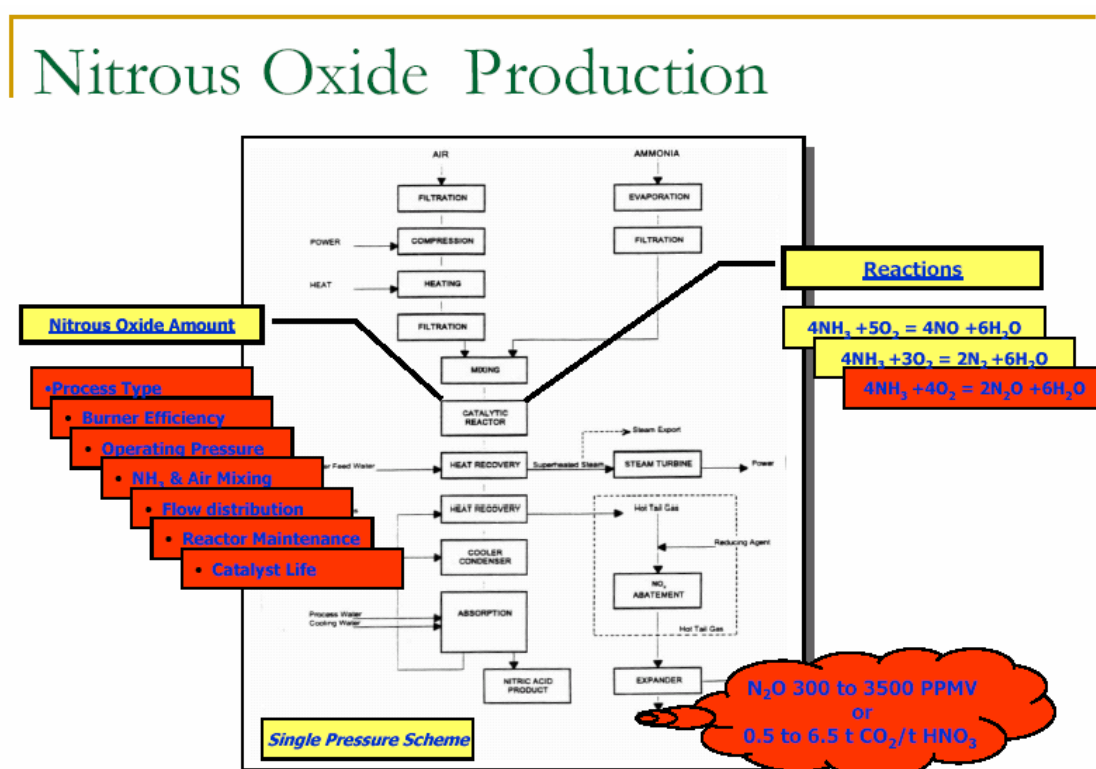
The proposed methodology is concerned with the Secondary approach where N_2O once formed is destroyed anywhere between the outlet of the ammonia oxidation gauzes and the inlet to the absorption tower. The preferred position for the catalyst is in the basket directly after the gauzes.

The Secondary approach offers certain advantages:

- Ease of installation
- No new plant requirement
- Minimum modifications to the basket
- No additional plant downtime to install
- Minimum maintenance of the catalyst once installed it does not need to be touched for several years
- Minimum ongoing operational and maintenance costs
- No additional GHG gases are generated as there is not need to heat the gas as is the case with most tail end catalyst installations.
- Totally safe (been operating in several nitric acid plants for up to 5 years)

Nitric Acid Plant Production Process

Picture one nitric acid plant flow chart



The production of nitric acid (HNO_3) generates nitrous oxide (N_2O) as a by-product of the high temperature catalytic oxidation of ammonia (NH_3).



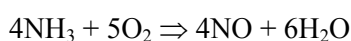
All plants for the production of nitric acid are currently based on the same basic chemical operations:-

- Oxidation of ammonia with air to give nitric oxide
- Oxidation of the nitric oxide to nitrogen dioxide and absorption in water to give a solution of nitric acid.

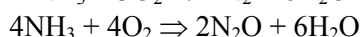
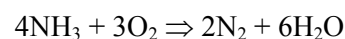
The efficiency of the first step is favoured by low pressure whereas that of the second is favored by high pressure. These considerations, combined with economic reasons give rise to two types of nitric acid plant, single pressure plants and dual pressure plants. In single pressure plant, the oxidation and absorption steps take place at essentially the same pressure. In dual pressure plants absorption takes place at a higher pressure than the oxidation stage. The production process typically consists of 3 steps:

1. Ammonia oxidation

Ammonia is reacted with air on platinum/rhodium alloy catalysts and nitric oxide and water are formed according to the following equation:

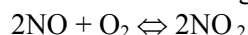


Simultaneously nitrous oxide, nitrogen and water are formed as well, in accordance with the following equations:



2. Nitric oxide oxidation

Nitric oxide is oxidized to nitrogen dioxide as the combustion gases are cooled, according to the equation:



For this purpose, secondary air is added to the gas mixture obtained from the ammonia oxidation to increase the oxygen content to such a level that the waste gas leaving the plant has a normal oxygen content of between 2% & 4% by volume.

3. Absorption

The absorber is operated with a counter-current flow of water. The absorption of the nitrogen dioxide and its reaction to nitric acid and nitric oxide take place simultaneously in the gaseous and liquid phases. These reactions depend on pressure and temperature to a large extent and are favored by higher pressure and lower temperature.





This reaction is exothermic and continuous cooling is therefore required within the absorber. As the conversion of NO to NO₂ is favored by low temperature, this reaction will take place significantly until the gases leave the absorption column.

Emissions

By far the major source of gaseous emissions is the tail gas from the acid absorption tower. This is a continuous emission and depending on the process, the gas at the outlet of the absorber may vary within the following limits during stable operation:

NO _x	100 to 3,500ppmv
N ₂ O	300 to 3,500ppmv
O ₂	1 to 4% by volume
H ₂ O	0.3 to 2% by volume

Nitrous oxide emissions depend on the pressure at which the nitric acid plant operates:

- (1) Low pressure approx 0.0042 Tonnes Nitrous Oxide (N₂O) produced per tonne Nitric Acid produced which is equivalent to 1.3 tonnes CO₂e per tonne Nitric Acid production.
- (2) Medium pressure approx 0.0074 Tonnes Nitrous Oxide (N₂O) produced per tonne Nitric Acid produced which is equivalent to 2.17 tonnes CO₂e per tonne Nitric Acid production.
- (3) High pressure approx 0.0097 Tonnes Nitrous Oxide (N₂O) produced per tonne Nitric Acid produced which is equivalent to 3.0 tonnes CO₂e per tonne Nitric Acid production

The technology to be employed in this project is owned and patented by BASF (German patent BASF Catalysts 03-80, 03-85, and 03-86). BASF has been involved in designing and installing catalysts for a wide range of processes for years and is recognized as a leader in the catalyst technology field. BASF has developed and installed a range of Denox units specifically for the removal of NO_x and catalyst for removal of N₂O from adipic acid plants. The development of N₂O removal technology for nitric acid plants is an extension of the know-how of the Research and Development Group of BASF.

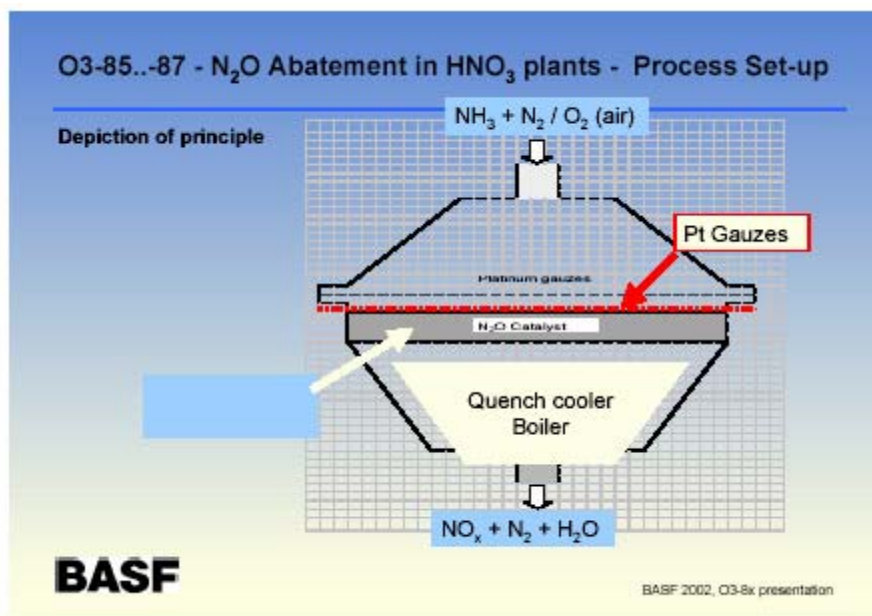
The N₂O catalyst has been installed and operated without problems in three facilities beginning back in 1997 and is currently being installed at BASF's Antwerp Nitric Acid Plant Number 3 in Antwerp, Belgium. The facilities in which catalyst has been installed and successfully operated include: BASF AG 03-85 Lu Nitric Acid Plant (1997), BASF NV 03-85 Antwerp Nitric Acid Plant 2 (1999), and Ube Industries 03-85 Yamaguchi Nitric Acid Plant (2001).

The technology employs the use of a proprietary catalytic material developed specifically to convert N₂O to N₂ and O₂. The novelty of the catalyst lies in its unique chemical and physical properties and its adaptability to specific plant operating conditions. The catalyst is composed by weight of 20% CuO, 16% ZnO, plus Al₂O₃ and promoters. The catalyst extrudates are either 3 mm star shaped or 5x5x2.5 mm ring tablets. The choice of shape depends on operating conditions of the plant.

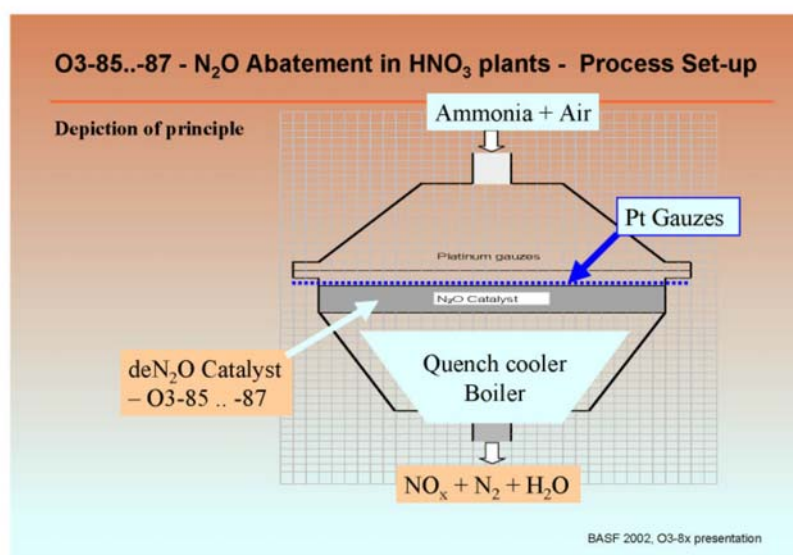


BASF catalyst can be used in low, medium, and high-pressure plants. As a secondary type catalyst, it is installed below the platinum gauze in the ammonia burner. The catalyst installation (shown below pictures 2 to 5) is straightforward. Catalyst is poured from drums into the burner basket directly under the platinum gauze and raked level. Catalyst installation is quick and can be done during a normal plant maintenance shutdown.

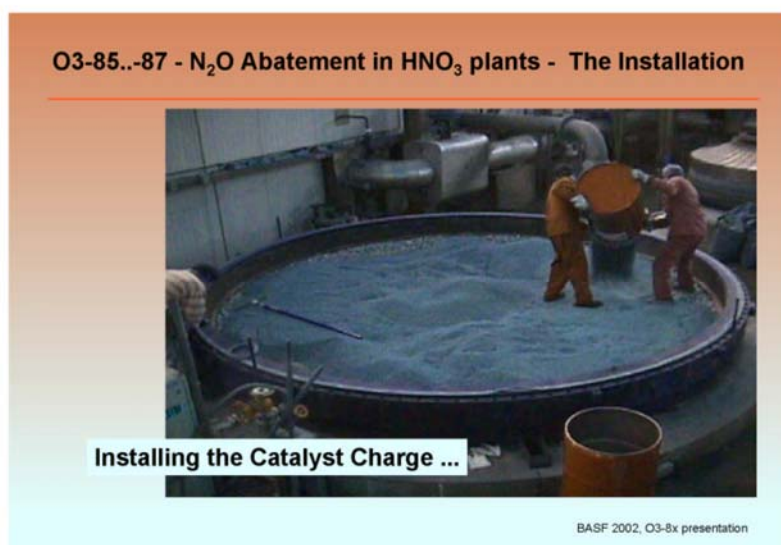
Picture two nitric acid reactor with no catalyst installed



Picture Three nitric acid reactor with catalyst installed



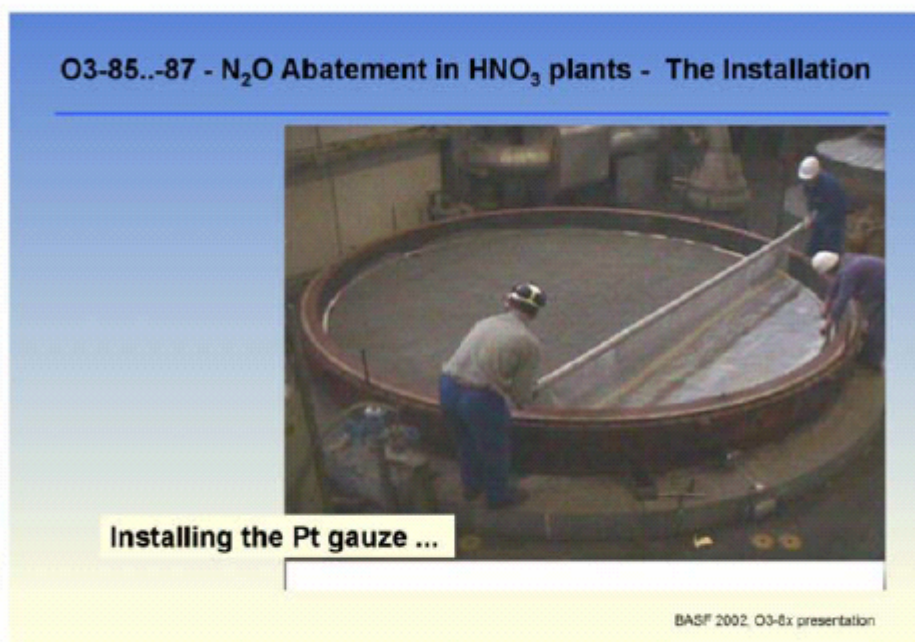
Picture Four installing the catalyst



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Picture Five installing the catalyst



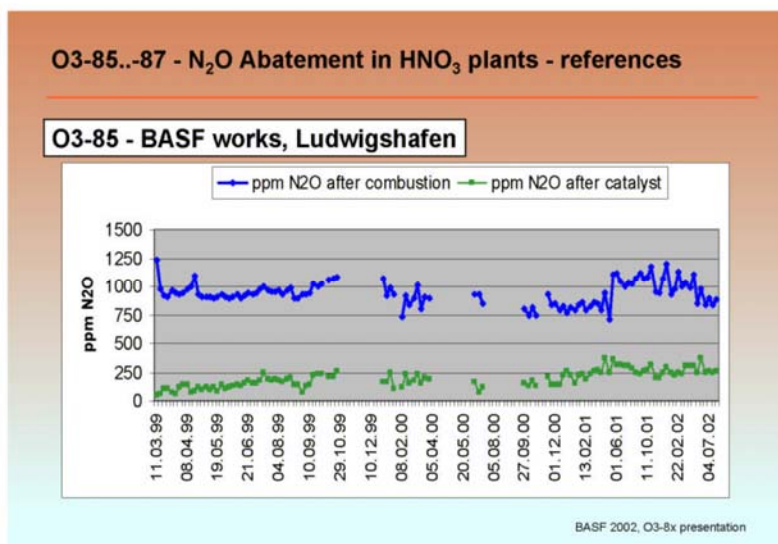
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Performance data showing the successful catalysis of N_2O is available from several operations. Typically, 90% reductions in N_2O emissions are achieved. Performance data for two plants is shown below graphs 1 & 2.

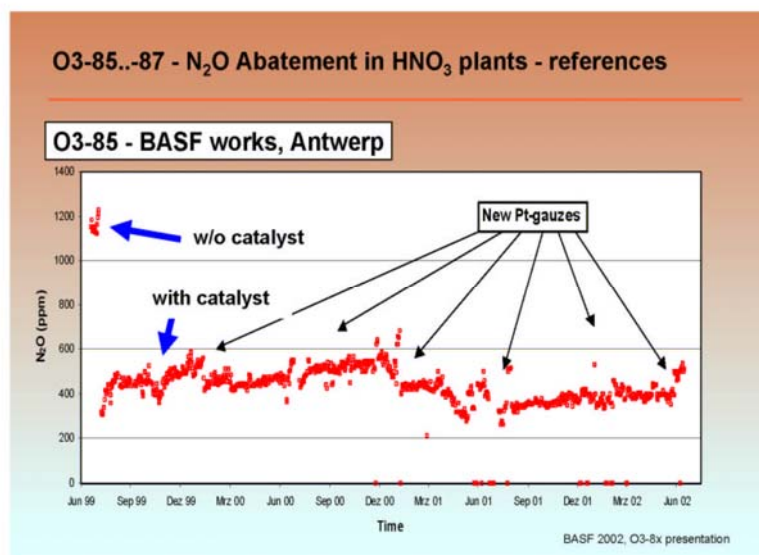
Graph 1



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Graph 2



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A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

As previously stated, N₂O is a by-product gas produced in the manufacture of nitric acid, and has a GWP of 310. The N₂O concentration in the off gas emitted by a nitric acid plant varies but generally is equivalent to 1,200ppmv. This represents close to 60% of the greenhouse gas equivalent emissions of a nitric acid plant. N₂O passes through the entire process as an inert gas and is emitted in the plant off gas to the atmosphere. N₂O is not destroyed in the DeNox reactors typically installed in the fuel gas. N₂O is a persistent and stable gas once formed. The concentration of N₂O can be reduced by 80% utilizing technology that converts the N₂O into O₂ and N₂, which have zero GWPs.

The NCIC plant at Nanjing is a medium pressure plant (5bar approx) and produces 1,100 tonnes of nitric acid per day. There are approximately 2.3 tonnes of CO_{2e} (i.e. N₂O) generated per tonne of nitric acid produced (see table N₂O default factors annex 3). On the basis of 80% abatement and 95% on line time, this will yield a CO_{2e} abatement of 662,153 tonnes per year.

The project will result in GHG emissions being lower than “business-as-usual” in the host country China. There is no commercial reason to implement the project other than N₂O abatement, and there is no benefit to the plant in production or other efficiencies and no adverse impact either.

(see table 1, all tables throughout this document uses conservative 80% N₂O destruction efficiency)

Table 1

Year ending	Baseline tonnes CO _{2e} per year (millions)	Projected Tonnes emissions per year as CO _{2e} (millions) after catalyst installed	Projected Tonnes emissions reductions per year as CO _{2e} (millions)	Cumulative tonnes emissions reductions CO _{2e} (millions)
2006	0.877277	0.215124	0.662153	0.662153
2007	0.877277	0.215124	0.662153	1.324306
2008	0.877277	0.215124	0.662153	1.986459
2009	0.877277	0.215124	0.662153	2.648612
2010	0.877277	0.215124	0.662153	3.310765
2011	0.877277	0.215124	0.662153	3.972918
2012	0.877277	0.215124	0.662153	4.635071
2013	0.877277	0.215124	0.662153	5.297224
2014	0.877277	0.215124	0.662153	5.959377
2015	0.877277	0.215124	0.662153	6.62153

Under business-as-usual conditions the project activity would not be implemented for the following reasons:

- Currently, there are no national regulations or legal obligations in China concerning N₂O emissions. It is unlikely that any such limits on N₂O emissions will be imposed in the near future. In fact, given the cost and complexity of suitable N₂O destruction or abatement technologies, it is unlikely that a limit would be introduced by a country that has ratified the Kyoto Protocol and actively participates in CDM.



- However, adjustments of legal regulations in China on N₂O emissions will be monitored. If legal regulations on N₂O emissions are introduced or altered during the crediting period, the baseline emissions will be adjusted immediately at the time the legislation has to be implemented.
- The installation of N₂O destruction facilities requires significant investment without additional economic benefits. The project activity would not be commercially viable even taking into account the market value of any potential by-product of the N₂O destruction technology without the revenues from the sales of the CERs. Although the production of nitric acid generates N₂O as a by-product, N₂O is typically released into the atmosphere as it does not have any economic value.

period:	A.4.4.1.	Estimated amount of emission reductions over the chosen crediting period:
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The implementation of the project activity will result in an ex-ante estimation of GHG emission reductions conservatively calculated at 4.653 million t CO₂e over the first seven-year crediting period. Please note - that estimates of GHG emission reductions are made for reference purposes only - actual emission reductions will be determined based on measurement results on ex-post basis. The global warming potential of N₂O is set at 310 according to the Kyoto Protocol rules. This estimate has been calculated using the following information: The NCIC plant at Nanjing produces 1,100 tonnes of nitric acid per day. There are approximately 2.3 tonnes of CO₂e (i.e. N₂O) generated per tonne of nitric acid produced. On the basis of conservative 80% abatement and 95% on line time, this will yield a CO₂e abatement of 662,153 tonnes per year (see table 3). Estimates of the tonnes of CO₂e abated for multiple years are as follows:

- 2006 – 2012 (7 years): 4,635,071
- 2006 – 2012 (7 years): 4,635,071
- 2006 – 2015 (10 years): 6,621,530
- 2006 – 2019 (14 years): 9,270,142

Table 3

Year ending	Baseline tonnes CO ₂ e per year (millions)	Projected Tonnes emissions per year as CO ₂ e (millions) after catalyst installed	Projected Tonnes emissions reductions per year as CO ₂ e (millions)
2005	0.877277	0.215124	0.662153
2006	0.877277	0.215124	0.662153
2007	0.877277	0.215124	0.662153
2008	0.877277	0.215124	0.662153
2009	0.877277	0.215124	0.662153
2010	0.877277	0.215124	0.662153
2011	0.877277	0.215124	0.662153
2012	0.877277	0.215124	0.662153
2013	0.877277	0.215124	0.662153
2014	0.877277	0.215124	0.662153

**A.4.5. Public funding of the project activity:**

No public funds are available for the financing of the project activity. Therefore Carbonventures and BASF will finance the project activity out of its own corporate funds.

SECTION B. Application of a baseline methodology**B.1. Title and reference of the approved baseline methodology applied to the project activity:**

There is currently no approved baseline methodology available for catalytic N₂O destruction at nitric acid plants. A new baseline methodology is therefore proposed.

Title: “Baseline Methodology for catalytic N₂O destruction in the Reactor gas of Nitric Acid Plants”

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

- ☒ Existing actual or historical emissions, as applicable;
- ☐ Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;
- ☐ The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.

There are three methods that can be used to measure N₂O in stack gases. They are:

- Direct continuous monitoring of N₂O emissions. This method provides the most accurate data.
- Application of site-specific emission factors. This is the second best option.
- Least accurate results are obtained by using default emission factors.

For the NCIC project, the direct continuous monitoring method for N₂O will be used which is the most accurate

The proposed project destroys N₂O from the nitric acid plant of NCIC. The selected baseline methodology for this project is “Baseline Methodology for catalytic N₂O destruction in the Reactor gas of Nitric Acid Plants”

The use of the methodology is justified because the following statements are true:

- The NCIC Sinopec nitric acid plant has currently *not* installed any N₂O destruction or abatement technology.
- The project activity will not result in any shut down of an existing N₂O destruction or abatement facility at Sinopec’s nitric acid plant.
- The project activity will not cause a nitric acid production increase.
- The N₂O baseline emissions and N₂O emissions related to the project activity will be measured in real time upstream and downstream of the N₂O destruction facility.

**B.2. Description of how the methodology is applied in the context of the project activity:**

The “Baseline Methodology for catalytic N₂O destruction in the tail gas of Nitric Acid Plants” is applied to the “Catalytic N₂O destruction project in the Reactor gas at the Nitric Acid Plant of Sinopec” in the following four steps:

The **first step** in determining the baseline scenario is to analyse all options available to project participants.

It includes the continuation of the status quo, the proposed project scenario and any other scenario that might be applicable.

Currently, there are no national regulations or legal obligations in China concerning N₂O emissions. It is unlikely that any such limits on N₂O emissions will be imposed in the near future. In fact, given the cost and complexity of suitable N₂O destruction and abatement technologies, it is unlikely that a limit would be introduced by China that has ratified the Kyoto Protocol and actively participates in CDM.

1. Status Quo:

At Sinopec’s nitric acid plant all national legal regulations are more than fulfilled. No N₂O destruction or abatement technology is installed and no legal obligation to do so is in force.

Consequently, Sinopec more than fulfils all legal obligations. There is no financial incentive and fund available for Sinopec to invest in a N₂O destruction or abatement technology.

2. Other Scenarios:

As discussed in A.4.3. there are three different groups of N₂O destruction or abatement technologies at nitric acid plants: primary, secondary or tertiary measures. Other scenarios than the proposed project scenario are primary or tertiary measures.

Generally, no legal obligation to reduce N₂O emissions is in force and Sinopec has no financial incentive to risk to install a primary and tertiary measures as:

- no legal obligation to limit N₂O emissions is in force in China;
- no grants or subsidies are available to implement a N₂O destruction or abatement technology;
- no income from any marketable product or by-product exists;
- primary or measures may cause a nitric acid production increase as they may influence the production process. Nevertheless, is expected that a potential production increase is too low to pay back investments and running costs for the N₂O abatement technology;
- the N₂O destruction from primary is less effective compared to secondary.

3. Proposed Project Scenario

Besides, no legal obligation to reduce N₂O emissions is in force and Sinopec has no financial incentive to risk to install a secondary measure as:

- no legal obligation to limit N₂O emissions is in force in China;
- no grants or subsidies are available to implement a N₂O destruction or abatement technology;
- no income from any marketable product or by-product exists;
- a secondary N₂O destruction technology does not cause a nitric acid production increase.

Sinopec gives technological preference to a secondary technology but has no legal obligation and no financial incentives to install an N₂O destruction or abatement technology.

The **second step** is a check of applicability conditions as described in proposed baseline methodology “Baseline Methodology for catalytic N₂O destruction in the tail gas of Nitric Acid Plants”. The conditions comprise a check

- (1) if any N₂O destruction or abatement technology has been installed and reduces the entire N₂O emissions



- (2) if the project activity will result in the shut down of an existing N₂O destruction or abatement facility
- (3) if the project activity will not cause a nitric acid production increase
- (4) if the N₂O baseline emissions and N₂O emissions related to the project activity are measurable.

According to the above mentioned applicability check, the use of the methodology is justified because:

- The Sinopec nitric acid plant has currently not installed any N₂O destruction or abatement technology.
- The project activity will not result in any shut down of an existing N₂O destruction or abatement facility at Sinopec's nitric acid plant.
- The project activity will not cause a nitric acid production increase.
- The N₂O baseline emissions and N₂O emissions related to the project activity will be measured real time upstream and downstream of the catalytic N₂O destruction facility.

The **third step** proves the additionality of the project activity as explained in section D.3 of the 'Baseline Methodology for catalytic N₂O destruction in the reactor gas of Nitric Acid Plants'. The additionality test consists in confirming and providing evidence to support each of the following four conditions:

Condition 1. At the starting date of the project activity the nitric acid plant complies with national regulations regarding N₂O emissions. Currently, there are no national regulations and legal obligations in China concerning N₂O emissions. It is unlikely that any such limits on N₂O emissions will be imposed in the near future. In fact, given the cost and complexity of suitable catalytic N₂O destruction technologies, it is unlikely that a limit would be introduced by China that has ratified the Kyoto Protocol and actively participates in the CDM. At Sinopec's nitric acid plant all national legal regulations are more than fulfilled. Sinopec more than fulfils all legal obligations and is in no need to invest in any N₂O destruction or abatement technology.

Therefore condition 1 is satisfied

Condition 2. The project activity is not common practice at nitric acid plants in the region.

Sub-step 1. Analyze other activities similar to the proposed project activity

Sinopec is the one of the largest fertilizer company in China and is one of the market leaders in China with a substantial market share of the Chinese market. No other fertilizer company in China is implementing the project activity

Sub-step 2. Discuss any similar options that are occurring

As no activities similar to the proposed project activity are identified, condition 2 is satisfied.

Condition 3. The project activity would not be commercially viable even taking into account the market value of any potential by-product of the N₂O destruction technology without the revenues from the sales of the CERs.

Sub-step 1. Determine appropriate analysis method

As the proposed project activity generates no financial or economical benefits other than CDM related income, Option I as stated in the applied baseline methodology (simple cost analysis) has been chosen to prove condition 3.

Sub-step 2. Option I. Simple cost analysis

No income from any kind of potential product or by-product except CERs are able to pay back investment costs as well as running costs for the installation of the secondary catalyst N₂O destruction system. No marketable product or by-product exists.

The investment costs (excluding potential financing costs) consists of the engineering, construction, shipping, erection, installation and commissioning of the secondary system and the measurement equipment. The running costs consist of the regular change of the catalysts as well as personnel costs for the supervision of secondary system and the measurement equipment.

Since no other benefits than CDM related income are identified, condition 3 is satisfied.

Condition 4. The financial benefits of the revenues obtained by selling CERs from the project activity will lead to the implementation of the project activity. Based on the ex-ante estimation of N₂O emission



reductions over the first crediting period, it is expected that the income from selling of CERs of the registered CDM project activity is at least as high as the investment, financing and running costs. Therefore CV/BASF is willing to finance the project activity under the condition of the registration of the project activity. Consequently condition 4 is satisfied and the proposed project activity is not the baseline scenario and the project activity is additional.

The **fourth step** describes the baseline scenario and determines the baseline emissions. The installation of the catalytic N₂O destruction technology requires a significant investment without additional economic benefit. Therefore, Sinopec will not implement any N₂O destruction or abatement technology. Hence, the continuation of the status quo is the baseline scenario for Sinopec taking all legal regulations into account. If legal regulations on N₂O emissions are introduced or altered during the crediting period, the baseline emissions will be adjusted immediately at the time the legislation has to be implemented. Thus the baseline emissions are defined as the N₂O emissions in absence of the project activity.

Key parameters for the determination of the baseline scenario are:

Key parameter	Detail	Data Source
Current legislation for N ₂ O abatement	None exists	Chinese Environmental law
Investment & running costs for the N ₂ O destruction facility	No financial incentive exists	
Income to finance the project activity	No other income exists	

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

Without implementation of the project, no reduction in N₂O emissions will occur. The plant has no commercial or regulatory reason to invest the considerable funds needed to install the catalyst and pay for its ongoing monitoring, maintenance, and replacement. It should be noted that the catalyst does not improve the production of nitric acid or any other plant efficiencies, and the only reason for installing the technology is to abate N₂O. Without the sale of the CER's generated by the project the NPV and IRR of the project would be negative, no revenue would be generated and the technology not installed.

The catalyst technology when installed will reduce the Nitrous Oxide emissions by up to 90% below what they would otherwise be without the catalyst technology installed.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

The only emission source of GHG gases relevant to the NCIC project is the N₂O contained in the waste gas stream exiting the stack. The abatement of N₂O is the only GHG gas under the control of the project participants.

N₂O is a by-product of the manufacture of nitric acid. It is formed alongside the main, desired product nitric oxide during the catalytic oxidation of ammonia over gauzes. N₂O typically passes through the rest of the nitric acid process unchanged and is emitted to the atmosphere in the tail gas as it does not have any economic value.

The project boundary encompasses all anthropogenic emissions by sources of greenhouse gases under the control of the project participants that are significant and reasonable attributable to the project activity.

These significantly and reasonably attributable GHG sources to the project activity are:

- N₂O concentration in the flow stream of the tail/stack gas



Based on this definition the project boundary covers the catalytic N₂O destruction facility at Sinopec's nitric acid plant .

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

The baseline measurement will be completed immediately following the Chinese Government approval of the NCIC project.

The baseline study will be undertaken on obtaining written assurances from the National Climate Change Coordination Committee NCCCC) as it would not be commercially sensible given the cost of the monitor and time to complete the baseline prior to approval being given.

Please note - that estimates of GHG baseline and emission reductions are made for reference purposes only using industry recognized default factors for N₂O emissions from nitric acid plants actual emission reductions will be determined based on measurement results on ex-post basis. At Sinopec's nitric acid plant the secondary catalyst will be placed in the reactor basket below the noble gauzes installation and sample points will be located in the gap between the noble gauzes and the catalyst to measure the inlet concentration of the N₂O prior to destruction by the catalyst. A second sample point will be located in the stack to measure the tail/stack gas N₂O concentration. This will allow for continuous on line baseline measurement and continuous on line emission reduction measurement.

The measurement equipment consists of the following components:

- Volume flow rate measurement equipment for reactor air flow, reactor ammonia gas flow, tail/stack gas flow rate;
- N₂O concentration analyser (the gas samples are taken automatically from upstream and downstream of the N₂O destruction facility, the switchover taking place automatically)

Detailed baseline information is provided in Annex 3 to this PDD.

The baseline determination will be conducted by Carbon Ventures

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SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The project is an add-on modification to a nitric acid plant. It will be funded entirely by the sale of greenhouse credits. The project can be started at any time once Chinese government approval has been given and will require 3 months of design, procurement, and construction before it becomes operational. If the approval is granted quickly, then the project could commence in Jan 1 2006.

C.1.2. Expected operational lifetime of the project activity:

The project lifetime will correspond to the operational life of the existing plant. The plant was built in 1934 and upgraded in 2002 to add an extra 20,000 tonnes a year capacity. The operational life of a plant is nominally 25 years. We believe that the plant will continue to operate at least until 2027.

**C.2 Choice of the crediting period and related information:****C.2.1. Renewable crediting period****C.2.1.1. Starting date of the first crediting period:****C.2.1.2. Length of the first crediting period:****C.2.2. Fixed crediting period:****C.2.2.1. Starting date:**

1/1/2006

C.2.2.2. Length:

10 years

SECTION D. Application of a monitoring methodology and plan**D.1. Name and reference of approved monitoring methodology applied to the project activity:**

There is currently no approved monitoring methodology available for catalytic N₂O reduction at nitric acid plants. A new monitoring methodology is therefore proposed. The methodology should be used in conjunction with the baseline methodology proposed above.

Title: “Monitoring Methodology for catalytic N₂O destruction in the Reactor gas of Nitric Acid Plants”

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

The proposed project activity will be implemented in the nitric acid plant of Sinopec. The project comprises the installation of a catalytic N₂O destruction facility in the reactor gas of Sinopec’s nitric acid plant. There is no indication that legal regulations and obligations regarding N₂O emissions will be implemented in China. Nevertheless observation of the Chinese regulations on N₂O emissions will be part of the monitoring.

The use of the monitoring methodology is justified because the following statements are true:

- The Sinopec nitric acid plant has currently not installed any N₂O destruction or abatement technology.
- The project activity will not result in any shut down of an existing N₂O destruction or abatement facility Sinopec’s nitric acid plant.
- The project activity will not cause a nitric acid production increase.
- The N₂O baseline emissions and N₂O emissions related to the project activity will be measured real time upstream and downstream of the catalytic N₂O destruction facility.

**D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario**

D.2.1.1. Data to be collected in order to monitor emissions from the <u>project activity</u>, and how this data will be archived:								
ID number <i>(Please use numbers to ease cross-referencing to table B.7)</i>	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
<i>A1 TGF</i>	<i>Q_{TG} Volume flow tail/stack gas after N₂O destruction facility</i>	<i>Tail/Stack Gas Measuring device, data management system</i>	<i>Cubic metres / hour</i>	<i>Measured continuously</i>	<i>Hourly/daily/ weekly/monthly</i>	<i>100%</i>	<i>electronic</i>	<i>Data records will be maintained for a period of 12 years. Flow metering system will automatically record flow adjusted to standard temperature and pressure</i>
<i>A2 N₂O (Tail/stack)</i>	<i>N₂O_{co}_TG_O N₂O concentration after destruction facility</i>	<i>Gas concentration , measuring device , data management system</i>	<i>tN₂O/m₃</i>	<i>Measured continuously</i>	<i>Hourly/daily/ weekly/monthly</i>	<i>100%</i>	<i>electronic</i>	<i>Data records will be maintained for a period of 12 years.</i>
<i>A3 Time period</i>	<i>M_h Operation hours in period</i>	<i>Measuring device, data management system</i>	<i>h</i>	<i>Measured continuously</i>	<i>Hourly/daily/ weekly/monthly</i>	<i>100%</i>	<i>electronic</i>	<i>Data records will be maintained for a period of 12 years.</i>



D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

Calculation of the project N₂O Emissions

The direct emissions from the project activity are equivalent to the N₂O emissions not destroyed plus emissions related to the operation of the N₂O destruction facility (emissions from additional ammonia and hydrocarbon input).

Total project emissions in period P_E_p [tCO₂e] are given by:

$$P_{E_p} = P_{N_2O_b_p} + DF_{O_E_p}$$

where:

P_E_p	Total project emissions in period	[tCO ₂ e]
P_N ₂ O_b_p	N ₂ O based project emissions (N ₂ O not destroyed)	[tCO ₂ e]
DF_O_E_p	Emissions related to the operation DF	[tCO ₂ e]

The **first part** of the project emissions consists of the N₂O not destroyed by the project activity. The N₂O project emissions monitoring equipment will measure the tail/stack gas volume flow (flow rate, temperature and pressure automatically present the volume flow rate of the tail gas at standard temperature and pressure) and (2) the N₂O concentration at the outlet of the N₂O destruction facility (DF)(sample point in the stack). The amount of N₂O at the outlet of the N₂O destruction facility can then directly be calculated by multiplying the tail/stack gas volume flow and the N₂O concentration.

The emissions of non destroyed N₂O over a period are given by:

$$P_{N_2O_b_p} = P_{N_2O_p} * GWP_{N_2O} = (Q_{TG} * N_2O_{co_TG_O} * M_h) * GWP_{N_2O}$$

where:

P_N ₂ O_b_p	N ₂ O based project emissions (N ₂ O not destroyed)	[tCO ₂ e]
P_N ₂ O_p	Project N ₂ O emissions	[tN ₂ O]
GWP_N ₂ O	N ₂ O Global warming potential of N ₂ O	[-]
Q_TG	Volume flow rate of tail/stack gas in DF	[m ³ /h]
N ₂ O_co_TG_O	N ₂ O concentration outlet DF	[tN ₂ O/m ³]
M_h	Operating hours in period	[h]

The global warming potential of N₂O is set at 310 according to the Kyoto Protocol rules.



D.2.1.3. Relevant data necessary for determining the <u>baseline</u> of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number (Please use numbers to ease cross-referencing to table D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B1 RGF	<i>Q_RG</i> Volume flow reactor gas before N ₂ O destruction facility	Reactor gas flow, data management systems	Cubic metres / hour	Calculated continuously	hourly/daily/weekly/monthly	100%	Electronic for period 12 years	Data records will be maintained for a period of 12 years. Flow metering system will automatically record flow adjusted to standard temperature and pressure
B2 N ₂ O Reactor	<i>N₂O_co_RG_O</i> N ₂ O concentration before destruction facility	Gas concentration measuring device, data management system	tN ₂ O/m ₃	Measured continuously	hourly/daily/weekly/monthly	100%	Electronic for period 12 years	Data records will be maintained for a period of 12 years.
B3 Nitric acid production	<i>P_HNO₃_p</i>	Annual reports	tonnes	Measured	monthly	100%	Electronic for period 12 years	Data records will be maintained for a period of 12 years
B4 RAmGF	<i>Q_RAmGF</i> Volume flow reactor ammonia gas flow before N ₂ O destruction facility	Reactor ammonia gas flow, gas measuring device, data management system	Cubic metres / hour	Measured continuously	hourly/daily/weekly/monthly	100%	Electronic for period 12 years	Data records will be maintained for a period of 12 years. Flow metering system will automatically record flow adjusted to standard temperature and pressure



<i>B5 RAGF</i>	<i>Q_RAGF Volume flow reactor air gas flow before N₂O destruction facility</i>	<i>Reactor air flow, gas measuring device, data management system</i>	<i>Cubic metres / hour</i>	<i>Measured continuously</i>	<i>hourly/daily/weekly/monthly</i>	<i>100%</i>	<i>Electronic for period 12 years</i>	<i>Data records will be maintained for a period of 12 years. Flow metering system will automatically record flow adjusted to standard temperature and pressure</i>
<i>B6 Reg 1</i>	<i>Reg_1_N₂O_E Regulation 1 absolute quantity N₂O limited</i>	<i>National legislation</i>	<i>Tonnes N₂O</i>	<i>Calculated</i>	<i>At date of introduction or change of regulation</i>	<i>100%</i>	<i>Electronic for period 12 years</i>	<i>Data records will be maintained for a period of 12 years.</i>
<i>B7 Reg 2</i>	<i>Reg_2_N₂O_E Regulation 2 N₂O emissions per unit of product life</i>	<i>National legislation</i>	<i>Tonnes N₂O per tonne HNO₃</i>	<i>Calculated</i>	<i>At date of introduction or change of regulation</i>	<i>100%</i>	<i>Electronic for period 12 years</i>	<i>Data records will be maintained for a period of 12 years.</i>
<i>B8 Reg 3</i>	<i>Reg_3_N₂O_E Regulation III: N₂O concentration in tail gas limited</i>	<i>National legislation</i>	<i>Tonnes N₂O per M₃</i>	<i>Calculated</i>	<i>At date of introduction or change of regulation</i>	<i>100%</i>	<i>Electronic for period 12 years</i>	<i>Data records will be maintained for a period of 12 years.</i>



D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

Baseline emissions are calculated based on the quantity of N₂O emitted in the baseline scenario taking national regulations into consideration. The quantity of N₂O is determined based on the measurement of the N₂O at the inlet of the N₂O destruction facility, which results in a conservative estimation of baseline emissions.

The N₂O baseline emissions monitoring equipment will

- (1) calculate the Reactor gas flow being the sum of the measured Reactor air flow and Reactor ammonia gas flow (temperature and pressure are also measured and the volume flow rate automatically corrected to standard temperature and pressure) and
- (2) the N₂O concentration at the inlet of the N₂O destruction facility. The amount of N₂O baseline emissions can then directly be calculated by multiplying the Reactor gas volume flow and the N₂O concentration at the inlet to the destruction facility.

Total baseline emissions in period (p) BL_E_p [tCO₂e] are given by:

$$BL_E_p = BL_N_2O_E_p * GWP_N_2O$$

where:

BL_E_p	Total baseline emissions in period	[tCO ₂ e]
BL_N ₂ O_E_p	Quantity of baseline N ₂ O emissions in period	[tN ₂ O]
GWP_N ₂ O	Global warming potential of N ₂ O [-]	

The global warming potential of N₂O is set at 310 according to the Kyoto Protocol rules.

Depending on the implementation of regulations for N₂O emissions and the character of the regulation, baseline N₂O emissions (BL_N₂O_E_p) are calculated as shown below.

Case 1: No legal regulations for N₂O existing:

The quantity of baseline N₂O emissions in the period (BL_N₂O_E_p) are:

$$BL_N_2O_E_p = Q_N_2O_I_DF_m_p$$

where:

BL_N ₂ O_E_p	Quantity of baseline N ₂ O emissions in period	[tN ₂ O]
Q_N ₂ O_I_DF_m_p	Quantity of N ₂ O emissions at the inlet DF	[tN ₂ O]

The quantity of N₂O emissions at the inlet of the N₂O destruction facility (DF) is calculated based on Calculated Reactor gas volume flow rate and the

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N₂O concentration at the inlet of the N₂O destruction facility. Therefore the quantity of N₂O at the inlet is given by:

$$Q_{N_2O_I_DF_m_p} = Q_{RG} * N_{2O_co_RG_I} * M_h$$

where:

$Q_{N_2O_I_DF_m_p}$	Quantity of N ₂ O emissions at the inlet DF	[tN ₂ O]
Q_{RG}	Volume flow rate Reactor gas	DF [m ³ /h]
$N_{2O_co_RG_I}$	concentration measured inlet DF	[tN ₂ O/m ³]
M_h	Operation hours in period	[h]

Case 2: Legal regulations for N₂O are implemented:

In case national regulations concerning the N₂O emissions are implemented during the crediting period, the impact on baseline N₂O emissions is considered without any delay by adjusting the measured N₂O emissions, at the time regulation has to be implemented. Depending on the character of the regulation the adjustment is done as shown below:

Case 2.1: Regulation setting of a threshold of an absolute quantity of N₂O emissions per nitric acid plant and per time:

Baseline N₂O emissions are limited by the absolute quantity of N₂O emissions given by the regulation. If the measured baseline N₂O emissions are exceeding the regulative limit, then measured baseline N₂O emissions are substituted by the regulative limit.

This leads to the following condition:

If,

$$Q_{N_2O_I_DF_m_p} > Reg_1_N_{2O_E}$$

then,

$$BL_N_{2O_E_p} = Reg_1_N_{2O_E}$$

else,

$$BL_N_{2O_E_p} = Q_{N_2O_I_DF_m_p}$$

where:

$Q_{N_2O_I_DF_m_p}$	Quantity of N ₂ O emissions at the inlet DF	[tN ₂ O]
$Reg_1_N_{2O_E}$	Regulative limit 1 of N ₂ O emissions in period	[tN ₂ O]
$BL_N_{2O_E_p}$	Quantity of baseline N ₂ O emissions in period	[tN ₂ O]

The quantity of N₂O emissions at the inlet of the N₂O destruction facility (DF) is calculated based on measurement of the Calculated Reactor gas volume flow and the N₂O concentration at the inlet of the N₂O destruction facility. Therefore the quantity of N₂O at the inlet of the N₂O destruction facility

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($Q_{N_2O_I_DF_m_p}$) is given by: $Q_{N_2O_I_DF_m_p} = Q_{RG} * N_2O_co_RG_I * M_h$

where:

$Q_{N_2O_I_DF_m_p}$	Quantity of N_2O emissions inlet DF	[tN ₂ O]
Q_{RG}	Volume flow rate Reactor gas DF	[m ³ /h]
$N_2O_co_RG_I$	concentration measured inlet DF	[tN ₂ O/m ³]
M_h	Operation hours in period	[h]

Case 2.2: Regulation setting of a threshold for specific N_2O emissions per unit of product:

This leads to the following condition:

If,

$N_2O_spec_m_output > Reg_2_N_2O_E_p$

then,

$BL_N_2O_E_p = Reg_2_N_2O_E_p * P_HNO_3_p$

else,

$BL_N_2O_E_p = Q_{N_2O_I_DF_m_p}$

where:

$N_2O_spec_m_output$	Specific N_2O emissions per output nitric acid	[tN ₂ O/tHNO ₃]
$Reg_2_N_2O_E_p$	Regulative limit 2 of N_2O emissions per product	[tN ₂ O/tHNO ₃]
$BL_N_2O_E_p$	Quantity of baseline N_2O emissions in period	[tN ₂ O]
$Q_{N_2O_I_DF_m_p}$	Quantity of N_2O emissions at inlet DF	[tN ₂ O]

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

$N_2O_spec_m_output = Q_{N_2O_I_DF_m_p} / P_HNO_3_p$

where:

$N_2O_spec_m_output$	Specific N_2O emissions per output nitric acid	[tN ₂ O/tHNO ₃]
$P_HNO_3_p$	Nitric acid production in period	[tHNO ₃]

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$Q_{N_2O_I_DF_m_p}$ Quantity of N_2O emissions at inlet DF [t N_2O]

The quantity of N_2O emissions at the inlet of the N_2O destruction facility ($Q_{N_2O_I_DF_m_p}$) is calculated based on the measurement of calculated Reactor tail gas volume flow rate and the N_2O concentration at the inlet of the N_2O destruction facility. Therefore the quantity of N_2O at the inlet is given by:

$$Q_{N_2O_I_DF_m_p} = Q_{RG} * N_2O_co_RG_I * M_h$$

where:

$Q_{N_2O_I_DF_m_p}$	Quantity of N_2O emissions inlet DF	[t N_2O]
Q_{RG}	Volume flow rate Reactor gas DF	[m ³ /h]
$N_2O_co_TG_I$	N_2O concentration measured inlet DF	[t N_2O /m ³]
M_h	Operation hours in period	[h]

Case 2.3: Regulation setting of a threshold for specific N_2O concentration flow in the tail/stack gas

This leads to the following condition:

If,

$$N_2O_co_TG_I > Reg_3_N_2O_E_p$$

then

$$BL_N_2O_E_p = Reg_3_N_2O_E_p * Q_{RG} * M_h$$

else,

$$BL_N_2O_E_p = Q_{N_2O_I_DF_m_p}$$

where:

$N_2O_co_RG_I$	N_2O concentration measured inlet DF	[t N_2O /m ³]
$Reg_3_N_2O_E_p$	Regulative limit 3 of specific N_2O concentration	[t N_2O /m ³]
$BL_N_2O_E_p$	Quantity of baseline N_2O emissions in period	[t N_2O]
$Q_{N_2O_I_DF_m_p}$	Quantity of N_2O emissions at inlet DF	[t N_2O]

The quantity of N_2O emissions at the inlet of the N_2O destruction facility ($Q_{N_2O_I_DF_m_p}$) is calculated based on measurement of the Reactor gas volume flow rate and the N_2O concentration at the inlet of the N_2O destruction facility. Therefore the quantity of N_2O at the inlet is given by:

$$Q_{N_2O_I_DF_m_p} = Q_{RG} * N_2O_co_RG_I * M_h$$

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where:

Q_N ₂ O_I_DF_m_p	Quantity of N ₂ O emissions inlet DF	[tN ₂ O]
Q_RG	Volume flow rate Reactor gas	DF [m ³ /h]
N ₂ O_co_RG_I	N ₂ O concentration measured inlet DF	[tN ₂ O/m ³]
M_h	Operation hours in period	[h]

D.2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Not applicable, Option 1 is chosen.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number (Please use numbers to ease cross-referencing to table D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.):

Not applicable, Option 1 is chosen.

**D.2.3. Treatment of leakage in the monitoring plan****D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity**

ID number (Please use numbers to ease cross-referencing to table D.3)	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

In case of the proposed project activity no significant change in anthropogenic emissions by sources of GHG outside the project boundary is identified. Therefore no monitoring mechanism is being suggested.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO₂ equ.)

The greenhouse gas emission reduction (ER_p) achieved by the project activity over a period is the difference between the total baseline emissions over the period (BL_{E_p}), the total project emissions over the period (P_{E_p}) and the leakage (L_{E_p}) which in this case is zero.

$$\begin{aligned}
 ER_p &= BL_{E_p} - P_{E_p} - L_{E_p} = \\
 &= (BL_{N_2O_{E_p}} * GWP_{N_2O}) - (P_{N_2O_p} * GWP_{N_2O}) - (L_{N_2O_p} * GWP_{N_2O}) \\
 &[tCO_2e]
 \end{aligned}$$

**D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored**

Data (Indicate table and ID number e.g. 3.-1.; 3.2.)	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
A1 TGF	low	Calibration procedure to be developed for routine calibration of gas flow meter to internationally recognised standards and in compliance with manufacturers specification
A2 N ₂ O	low	Calibration procedure to be developed for routine calibration of Nitrous Oxide monitor to internationally recognised standards and in compliance with manufacturers specification
A3 Time Period	low	Meters for measuring operations hours will be subject to regular calibration, maintenance and testing regime to ensure accuracy is maintained
B1 RGF (Calculated)	low	Calibration procedure to be developed for routine calibration of Reactor air flow meter and reactor ammonia gas meter to internationally recognised standards and in compliance with manufacturers specification
B2 N ₂ O	low	Calibration procedure to be developed for routine calibration of Nitrous Oxide monitor to internationally recognised standards and in compliance with manufacturers specification
B4 RAmGF	low	Calibration procedure to be developed for routine calibration of gas flow meter to internationally recognised standards and in compliance with manufacturers specification
B5 RAGF	low	Calibration procedure to be developed for routine calibration of gas flow meter to internationally recognised standards and in compliance with manufacturers specification

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

Sinopec will operate the secondary catalyst N₂O destruction facility and the measurement equipment. The company has been operating the fertilizer plant since the commissioning of the plant and has sufficient and well experienced staff to operate similar technologies. In case of any error the technology providers have the contractual obligations to set activities on site within 48 hours.

- After the installation of the catalyst the N₂O levels in the process will be measured continuously prior to the catalyst installation in the reactor before any N₂O abatement occurs and then in the stack after N₂O abatement has occurred. This will be done for the life of the project. N₂O concentrations will be measured continuously with an on line monitor at two locations. The first location will be in the reactor between the noble gauzes and the catalyst installation and the second location will be in the stack.
- The recording and storing of data will be computerised.
- Data readings of N₂O, Stack Gas Flow (SGF), Ammonia gas feed rate and air feed rate will be taken every 2 minutes. The Reactor Gas flow rate is the sum of the measured Ammonia Gas flow rate to the reactor and the measured Reactor Gas flow rate to the reactor.

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- Daily data records of N₂O concentration and SCF, Rector Air flow rate and Ammonia Gas Reactor flow rate, RGF (calculated) will be printed out every day.
- Daily, weekly and monthly data printouts will be archived on the first day of every month for the preceding month.

Gauge Calibration

The measurement gauge will be calibrated as per the manufactures instructions and maintained by properly trained and certified personnel and all records of calibration will be maintained.

Calibration records will be maintained for 12 years or two years after the life of the project.

D.5 Name of person/entity determining the <u>monitoring methodology</u>:

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CarbonVentures is a participant in the project

**SECTION E. Estimation of GHG emissions by sources****E.1. Estimate of GHG emissions by sources:**

N₂O emissions will be measured before and after the BASF catalyst installation and will be measured directly. N₂O concentration in flue gas exiting the facility will be measured on a continual basis using a Nitrous Oxide infrared absorption spectrometer.

The anthropogenic emissions of the proposed project activity within the project boundary consist of the emissions of non destroyed N₂O.

Ex-ante estimation of project emissions is made by projecting nitric acid output, N₂O formation, efficiency of the catalytic N₂O destruction process as well as the demand of hydrocarbon. Estimation is for reference purposes only, actual project and baseline emissions will be determined on measurement results on an ex-post basis. Assuming a conservative 80% N₂O destruction rate and a conservative specific N₂O formation rate (IPCC), ex-ante estimations will result in conservative estimation of project emissions (rather overestimation than underestimation).

Most likely, the expected N₂O destruction rate will be in the range of 90%.

Given the projected nitric acid production, volume flow rate of the tail gas, N₂O concentration in the tail gas at the outlet of the stack, the efficiency of the secondary catalyst N₂O destruction facility project emissions are estimated at about 215,124 tCO₂e per year.

Table 4 Estimated project emissions

Year ending	Projected Tonnes emissions per year as CO ₂ e (millions) after catalyst installed
2006	0.215124
2007	0.215124
2008	0.215124
2009	0.215124
2010	0.215124
2011	0.215124
2012	0.215124
2013	0.215124
2014	0.215124
2015	0.215124

E.2. Estimated leakage:

In case of the project activity no leakage is expected.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

With no leakage overall emission of the project are same as described in E.1.
(see table 5)



Table 5

Year ending	Projected Tonnes emissions per year as CO _{2e} (millions) after catalyst installed
2006	0.215124
2007	0.215124
2008	0.215124
2009	0.215124
2010	0.215124
2011	0.215124
2012	0.215124
2013	0.215124
2014	0.215124
2015	0.215124

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

Baseline emissions are estimated based on the quantity of N₂O emitted in the baseline scenario, taking national regulations into account. Ex-ante estimation of baseline emission is made by projecting the nitric acid output and the N₂O formation based on IPCC default factors. Estimations are for reference purposes only, actual baseline emissions will be determined on measurement results on an ex-post basis.

At present there are no national regulations on N₂O emissions in China. Furthermore it is unlikely that any limits on N₂O emissions will be imposed in the near future. However, national regulations will be monitored and taken into account. Given the projected nitric acid production, volume flow rate of the Reactor gas, N₂O concentration at the inlet to the N₂O destruction facility, the baseline emissions are estimated at about 877,277 tCO_{2e} per year.

Example using Industry default factors see table 6

Table 6

Year ending	Baseline tonnes CO _{2e} per year (millions)
2006	0.877277
2007	0.877277
2008	0.877277
2009	0.877277
2010	0.877277
2011	0.877277
2012	0.877277
2013	0.877277
2014	0.877277
2015	0.877277

**E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:**

The total Certified Emissions Reductions claimed by the NCIC Sinopec project shall be the difference between the measured tonnes of N₂O produced before the N₂O catalyst destruction facility in the nitric acid plant reactor compared to the measured tonnes N₂O remaining after the N₂O destruction facility multiplied by 310 to convert to tonnes CO₂e. (see table 7)

Table 7

Year ending	Baseline tonnes CO ₂ e per year (millions)	Projected Tonnes emissions per year as CO ₂ e (millions) after catalyst installed	Projected Tonnes emissions reductions per year as CO ₂ e (millions)
2006	0.877277	0.215124	0.662153
2007	0.877277	0.215124	0.662153
2008	0.877277	0.215124	0.662153
2009	0.877277	0.215124	0.662153
2010	0.877277	0.215124	0.662153
2011	0.877277	0.215124	0.662153
2012	0.877277	0.215124	0.662153
2013	0.877277	0.215124	0.662153
2014	0.877277	0.215124	0.662153
2015	0.877277	0.215124	0.662153

The greenhouse gas emission reduction (ER_p) achieved by the project activity over a period is the difference between the total baseline emissions over the period (BL_{E_p}), the total project emissions over the period (P_{E_p}) and the leakage (L_{E_p}) which in this case is zero.

$$\begin{aligned}
 ER_p &= BL_{E_p} - P_{E_p} - L_{E_p} = \\
 &= (BL_{N_2O_{E_p}} * GWP_{N_2O}) - (P_{N_2O_p} * GWP_{N_2O}) - (L_{N_2O_p} * GWP_{N_2O}) \\
 &[tCO_2e]
 \end{aligned}$$

E.6. Table providing values obtained when applying formulae above:

Estimated project emission reductions based on industry default emission factors (see Table 8)



Table 8

Year ending	Baseline tonnes CO _{2e} per year (millions)	Projected Tonnes emissions per year as CO _{2e} (millions) after catalyst installed	Projected Tonnes emissions reductions per year as CO _{2e} (millions)	Cumulative tonnes emissions reductions CO _{2e} (millions)
2006	0.877277	0.215124	0.662153	0.662153
2007	0.877277	0.215124	0.662153	1.324306
2008	0.877277	0.215124	0.662153	1.986459
2009	0.877277	0.215124	0.662153	2.648612
2010	0.877277	0.215124	0.662153	3.310765
2011	0.877277	0.215124	0.662153	3.972918
2012	0.877277	0.215124	0.662153	4.635071
2013	0.877277	0.215124	0.662153	5.297224
2014	0.877277	0.215124	0.662153	5.959377
2015	0.877277	0.215124	0.662153	6.62153

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Installation of the BASF catalyst will have no adverse environmental impacts including no trans-boundary impacts. Any environmental impact will be beneficial as the catalyst action will result in at least 80% of the N₂O being removed that would have previously been discharged to the atmosphere.

Social Benefits:

The project developer, the host country and the project operator agreed on spending a share of the total income from selling of the CERs for a Sustainability Fund and Social fund for the area of Nainjing, where Sinopec located. This fund shall contribute to the social benefit of the people living in the area of the CDM project activity by financing sustainable projects like projects in schools, hospitals, infrastructure etc

Economic Benefit:

The project developer agreed to pay a share of the total CERs generated to the Chinese government as well as a significant share of the income of the CERs to the project operator, who is one of the biggest job providers in the region.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The catalyst installation is simple being fitted underneath the platinum gauze in the existing nitric acid plant reactor. It does not require any additional plant. The catalyst is also inert and does not break down nor release any compounds. It is specific for the removal of Nitrous Oxide only.

The only environmental impact will be a positive one with at least a 80% reduction in a powerful greenhouse gas being emitted to the atmosphere. Life of the catalyst is greater than 5 years and its removal also poses no health, safety or environmental issues. However an environmental impact assessment is a requirement of the China government and will be carried out using a EIA checklist that



has been taken directly from the checklist currently used by the EU in assessing project development impacts.

SECTION G. Stakeholders' comments

Because of the nature of the project in that the installation of the catalyst requires no changes to plant infrastructure nor does the installation cause any adverse environmental impacts inside or outside the plant that might affect the workforce or local community.

G.1. Brief description how comments by local stakeholders have been invited and compiled:

Not applicable

G.2. Summary of the comments received:

Not applicable

G.3. Report on how due account was taken of any comments received:

Not applicable

Annex 1**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

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Annex 2**INFORMATION REGARDING PUBLIC FUNDING**

No public funds are available for the financing of the project activity. Therefore CarbonVentures and BASF will finance the project activity out of its own corporate funds.

Annex 3**BASELINE INFORMATION**New Baseline Methodology

The baseline approach that will be adopted for the NCIC project will Existing actual or historical emissions and relies on the direct measurement of the N₂O concentration in the stack gas before and after the N₂O catalyst destruction facility and the flow rate of the Reactor Ammonia gas flow rate, Reactor Air flow rate and the Tail/stack gas flow rate exiting the stack under normal operating conditions. These emissions will then be compared to the same measurements taken after catalyst installation (the proposed CDM activity).

Table 9 Baseline data for ex-ante estimations

Year ending	Baseline tonnes CO _{2e} per year (millions)	Projected Tonnes emissions per year as CO _{2e} (millions)after catalyst installed	Projected Tonnes emissions reductions per year as CO _{2e} (millions)	Cumulative tonnes emissions reductions CO _{2e} (millions)
2006	0.877277	0.215124	0.662153	0.662153
2007	0.877277	0.215124	0.662153	1.324306
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2013	0.877277	0.215124	0.662153	5.297224
2014	0.877277	0.215124	0.662153	5.959377
2015	0.877277	0.215124	0.662153	6.62153



Industry N₂O Default factors for Nitric Acid Plants

Technology	N ₂ O emission factor
	(kg N ₂ O /t HNO ₃)
Atmospheric pressure plant	4 - 5
Medium pressure plant (< 6 bar)	6 - 8
High pressure plant (> 7 bar)	9
Source: Norsk Hydro 2000 IPCC	

Annex 4

MONITORING PLAN

The “Catalytic N₂O destruction project in the tail gas of the Nitric Acid Plant of NCIC (Sinopec Fertilizer Co.” employs the latest state of the art monitoring and control equipment that measures, records and reports all key parameters to determine the GHG emission reductions.

The monitoring will involve the volume flow rate of the Reactor air flow, Reactor ammonia gas flow, tail/stack gas flow and the N₂O concentration in the inlet to the N₂O destruction facility and the N₂O concentration in the tail/stack gas.

The volume flow rate will be measured by using existing flow meters for the reactor air flow and reactor ammonia gas flow and a new installed flow meter in the stack to a international standard method (e.g. venture tube according to ISO 5167-4:2003; ISO 5267-4:2003). The monitoring system will automatically record volume under conditions of standard temperature and pressure. Also part of the volume flow rate monitoring system is the measurement of the tail gas temperature and tail gas pressure. The flow rate and the N₂O concentration, monitored upstream and downstream of the Secondary catalyst N₂O destruction facility are recorded on the emission monitoring computer. Data is automatically stored and can be recorded and displayed in trends and charts.

It is the responsibility of the Project Developer and Project Operator to ensure that required and experienced capacity is available and that their operational staff participate in training to be enable to operate the monitoring system properly. Initial training must be provided to the staff before the project activity starts operation. It is also the responsibility of the Project Developer and Project Operator to organise and implement a quality management system that ensures the integrity of the data.

The monitoring procedures will be fully integrated in Sinopec’s quality and environmental management system.

All monitoring equipment will be serviced, calibrated and maintained according to the manufacturers instructions and international standards. Monitoring principles such as monitoring frequencies and reporting will be implemented in accordance with international standards.

Parameters to be monitored are described in section D.
