



Voluntary Carbon Standard
Project Description Template

19 November 2007

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PD Version 3

Replaces PD Version 2 from 4 September 2009.

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1 Description of Project:

1.1 Project title

Catalytic Reduction of N₂O inside the Ammonia Burners of the Nitric Acid Plant in Caojing, Shanghai

1.2 Type/Category of the project

The project applies CDM EB-approved methodologies and tools in their latest version. The CDM program is a VCS approved program.

The respective sectoral scope is scope 5: chemical industry.

The project is not a grouped project.

1.3 Estimated amount of emission reductions over the crediting period including project size:

The anticipated project start date is 1st October 2009.

With an annual production of up to 265,000 tons of nitric acid (as 100% concentrate), an estimated plant specific emissions factor of 7.5 kgN₂O/tHNO₃ and an expected minimum abatement efficiency of 80%, the following reduction amounts are expected.

Length of crediting period	10 years
Year	Estimate of annual emission reductions in tons of CO ₂ e
2009 (Oct - Dec)	123,225
2010	492,900
2011	492,900
2012	492,900
2013	492,900*
2014	492,900*
2015	492,900*
2016	492,900*
2017	492,900*
2018	492,900*
2019 (Jan - Sept)	369,675*
Total estimated reductions [tCO ₂ e]	4,929,000
Annual average of estimated emission reductions [tCO ₂ e]	492,900

* For calculation of reductions from 2013 onwards the currently valid GWP of N₂O from IPCC AR2 (310) has been applied. This value shall be reassessed in the light of then valid CDM regulation in 2013.

Table 1: Emission reduction volume during crediting period

1.4 A brief description of the project:

The nitric acid plant at Caojing, licensed by Tecnicas Reunidas (Espindesa) from Spain, started nitric acid production on 15 July 2006. The production capacity of the plant is 265,000 t per year (as 100% concentration equivalent) or 1,200 t/d (68% nitric acid). Generally, this produce is used as raw material for TDI and crude MDI production.¹

The project at hand intends a substantial emission reduction from the nitric acid production process at Caojing by installation of a N₂O decomposition catalyst right below the platinum gauze in the ammonia oxidation reactor as a secondary abatement measure.

The N₂O decomposition catalyst shall be installed in mid-2009 or by that year's end, following a six months baseline measurement period. Estimated N₂O emission reductions are expected to reach 80 % of current regular emissions. Thus they are expected to amount to 4,929,000 tCO₂e over the whole crediting period or 492,900 tCO₂e p.a.

With no economic benefit from N₂O abatement and the absence of any legal obligation, the emission reductions will only be realized if the investment and the ongoing costs for the secondary abatement can be financed by a VCS project.

1.5 Project location including geographic and physical information allowing the unique identification and delineation of the specific extent of the project:

The nitric acid plant of Shanghai BASF Polyurethane Co., Ltd. (SBPC), and all connected facilities are located at the production site at Shanghai Chemical Industry Park (SCIP) in Caojing, Municipality of Shanghai. The nitric acid production is housed in buildings block A615 of SBPC.

The exact address is:

No. 25 Chu Hua Road
Caojing, Shanghai
zip code 201507
People's Republic of China

The following images give an overview of the location on different levels (national, regional, communal, plant level). The nitric acid production is housed in Block A615 of SBPC plant.

¹ TDI (Toluene diisocyanate), MDI (Diphenylmethane diisocyanate). Plants for production of these materials and thus the main consumers of the produce are located on the SBPC site as well.



Figure 1: Location of SCIP in the suburban area of Shanghai and Shanghai in China, see red dot.



Figure 2: Location of the SBPC nitric acid plant in SCIP, see red dot



Figure 3: View of SBPC nitric acid production plan

Coordinates of the plant

Lat: 30° 47' 13'' N

Lon: 121° 27' 51'' E

1.6 Duration of the project activity/crediting period:

A renewable crediting period over 10 years shall apply. First verifiable emission reductions shall be achieved in October 2009. Thus the first crediting period shall last from October 2009 until September 2019.

1.7 Conditions prior to project initiation:

The nitric acid plant in Caojing consists of one single production line, fed by one ammonia oxidation reactor, supplying NO gas to the absorption process train. To create a higher pressure in the absorption section, a compressor is installed between the cooler condenser and the absorption column. With excessive O₂ in the process train, NO oxidizes to NO₂ which is then available for the absorption in water and the reaction to nitric acid in the absorption columns. With the help of ammonia, the tail gas undergoes a selective catalytic reduction (SCR) of NO_x residues - thus keeping NO_x emissions under the

threshold value specified by Chinese regulation (50 mg/m^3 for plants of joint ventures)² – before it is being sent to the stack.

With a normal operating pressure of 3.10 barg in the oxidation reactor and 11.05 barg in the absorption stage (at 100% capacity), the nitric acid plant belongs to the Dual Medium/High (M/H) pressure plant type. Figure 4 below shows the principle plant layout.

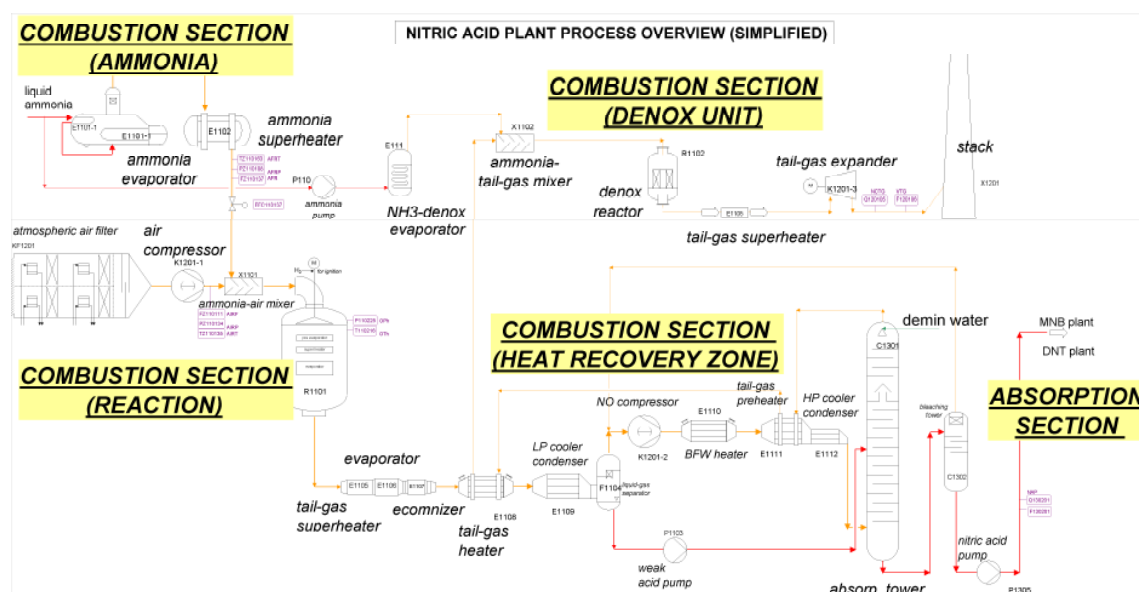


Figure 4: Plan of the nitric acid plant

Nitrous oxide (N_2O) generation during the production of nitric acid is an unavoidable side reaction of the ammonia oxidation process. Nitrogen oxidation steps under overall reducing conditions are considered to be potential sources of N_2O .³ Reactions that lead to the formation of N_2O are undesirable in that they decrease the conversion efficiency of NH_3 and thus reduce the yield of the desired NO product. Therefore it is in the interest of the nitric acid producer to optimize the operating conditions in a way, that as little N_2O as possible is formed at the platinum gauze. The unavoidable amounts of N_2O – having no economical value – are vented to the atmosphere via the waste gas stream.

At Caojing nitric acid plant the N_2O emissions occur with an intensity of ca. $7.5 \text{ kg N}_2\text{O}$ per tonne nitric acid production, leading to estimated overall emissions of some 1,987.5 tonnes of N_2O , equal to 616,125 tCO_2e per year. Such N_2O emissions are common in the nitric acid industry worldwide.

² The plant permission was issued by the Shanghai Administration of Work Safety on the basis of a the results of a Environmental Impact Assessment of Integrated Isocyanate Project as well as on other approvals (permit for occupational safety, fire fighting etc.). It has come into effect on 26 June 2006.

³ See 2006 IPCC Guidelines for National Greenhouse Gas Inventories, p. 3.19

1.8 A description of how the project will achieve GHG emission reductions and/or removal enhancements:

Nitric Acid is generally produced through the oxidation of ammonia (NH_3) on precious metal catalyst gauzes in the ammonia burner of a nitric acid plant. As described above this reaction is connected with unavoidable formation of N_2O .

The Caojing N_2O mitigation project intends to achieve considerable emission reduction by installation of a secondary N_2O abatement facility. Some experience regarding the large scale application of this technology - further described in 1.9 below - does already exist. However, secondary N_2O abatement is not common practice in China nor is it currently required by Chinese regulation. The first systems have been installed with the help of CDM financing also in China (cf. registered Chinese CDM projects for N_2O abatement).⁴ Still the installation of N_2O abatement systems is exceptional. This is so because of the connected high investment as well as technical uncertainties.

A detailed analysis of alternative activities and barriers for the project implementation within the PD will show that the project activity and the associated greenhouse gas emission reductions are additional to what would occur in the absence of the VCS project.

1.9 Project technologies, products, services and the expected level of activity:

For achieving the intended N_2O mitigation, a decomposition catalyst shall be installed right below the platinum gauze in the high temperature zone of the reactor (830-900 °C). With the help of the N_2O decomposition catalyst, which is patented and produced by BASF, the N_2O load in the combustion gas can be reduced from a range of 1000 to 1,300 ppmv to less than 200 ppmv, depending on technical conditions.

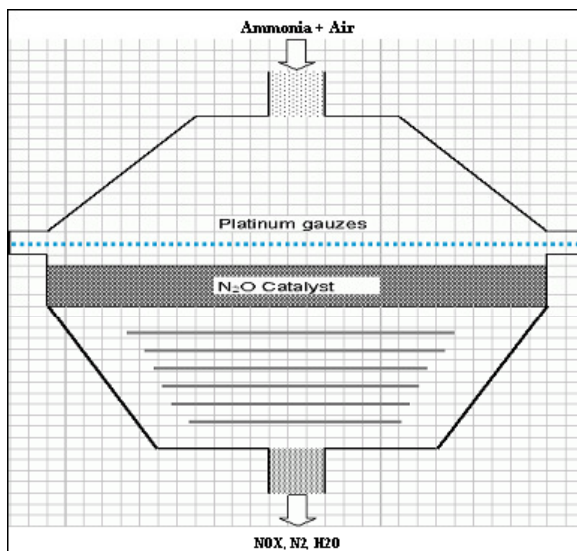


Figure 5: Scheme of reactor and basket with N_2O decomposition catalyst

⁴ See documentation of registered projects at: <http://cdm.unfccc.int>, accessed in June 2009.

1.10 Compliance with relevant local laws and regulations related to the project:

The NO_x emission level is being kept under the threshold value specified by Chinese regulation (50 mg/m³ for plants of joint ventures).

There are no local regulatory requirements which apply to plant modifications as planned by the VCS project.

1.11 Identification of risks that may substantially affect the project's GHG emission reductions or removal enhancements:

At constant production of the plant the only factor which could possibly affect the emission reductions is the efficiency of the abatement catalyst. Based on the year-long experience by BASF with the application of the abatement technology this, risk can be estimated to be rather low.

1.12 Demonstration to confirm that the project was not implemented to create GHG emissions primarily for the purpose of its subsequent removal or destruction.

It can be excluded that project-based climate finance has led to the plant investment at Caojing, thus setting a perverse incentive: Neither the choice of technology nor of design capacity of the plant has been influenced by consideration regarding the eventuality of possible further income stream like VCS/CDM revenue.

In deviation from AM0034 requirements the Caojing project takes place at a plant which went in operation only after 2005. At the same time this deviation is adequate and well justified as all possible objections/concerns regarding the eventuality of "gaming" can be met by verifiably demonstrating that N₂O emissions were not deliberately increased:⁵

- The facility with its technical design, provided by Tecnicas Reunidas, was state of the art at time of ordering (January 2003).
- At the time of construction and commissioning, abatement technology in general and secondary abatement technology in particular was still in its early development stages and no viable option on the market yet.
- By the beginning of 2003 the prospects of using the VCS/CDM were still rather vague. Applied methodology AM0034 was only adopted in July 2006 while methodology AM0028 (used for baseline definition) is from Oct. 2004. Furthermore, CDM is even generally excluded due to the fact that a non-resident company owns the majority of the plant and the national DNA does not

⁵ In an answer to a request for clarification on AM0034 put forward by DNV, the EB has justified the applicability criteria "before 2005", stating: "The purpose of this condition is to avoid possibility of gaming in order to deliberately increase the by product N₂O." cf. "Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants"; AM_CLA_0032.

allow such projects to be approved. At that time though it was planned to finish the construction work until the end of 2005. Actually planning for the build-up of the facility started even years before the commissioning in 1998. As early as 2001 planning had already evolved that much, that an environmental impact assessment could be conducted. Evidence for this timeline will be provided at validation. With respect to the VCS as source of finance it shall be highlighted that plant operation began in mid 2006 and thus much earlier than the establishment of the VCS Standard at the end of 2007. The management board decision to go for an application of mitigation technology and a VCS project was made in February 2008.

- The HNO₃ plant Caojing was planned at the same time and is now operating as a component in a far bigger production chain (Integral Isocyanate Project, IIP, on this see also 1.4 and 1.5). In fact all of the produced HNO₃ is used on the site as raw material for TDI and crude MDI production. Thus the decision for the build-up of the HNO₃ plant at Caojing with the now existing capacity has been only one – though crucial – part of a far bigger investment decision. It can be shown that the relation of the now expected income from climate finance is negligible in relation to the all-over investment decision.

Thus it is fair to conclude that neither the option for investment in China nor the option for the established facility design was chosen under any consideration of using the Kyoto mechanisms for generating revenue. It is evident that no “gaming” has taken place. Today’s abatement planning serves the objective to reduce accruing emissions from the installed installation and is not connected with the commissioning of the given installation.

1.13 Demonstration that the project has not created another form of environmental credit (for example renewable energy certificates).

The project has not created any form of other credit.

1.14 Project rejected under other GHG programs (if applicable):

The Caojing mitigation project has not applied for crediting by any other GHG program. It has not been rejected from any other GHG program.

1.15 Project proponents roles and responsibilities, including contact information of the project proponent, other project participants:

The project proponent is Shanghai BASF Polyurethane Co., Ltd. The following directions apply:

Organization:	Shanghai BASF Polyurethane Co., Ltd. (SBPC)
Street/P.O.Box:	No. 25 Chu Hua Road
Building:	
City:	Caojing, Shanghai

State/Region:	Municipality of Shanghai (provincial status)
Postcode/ZIP:	zip code 201507
Country:	People's Republic of China
Direct FAX:	0086-21-67121118
Direct tel:	0086-21-37503000
Personal e-mail:	daiwtj@s-basf-pc.com.cn (Mr. Jeff Dai; Project Leader SBPC)

The baseline determination and monitoring plan was defined and documented by Shanghai BASF Polyurethane Co., Ltd. (SBPC) in cooperation with BASF SE and FutureCamp Climate GmbH.

1.16 Any information relevant for the eligibility of the project and quantification of emission reductions or removal enhancements, including legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and temporal information.):

Project Eligibility:

Although the project cannot be staged under the CDM for ownership reasons (foreign ownership), still CDM methodology shall be applied. Pertaining thus to a VCS approved GHG program, the project at hand shall be eligible also under the VCS.

Quantification of Emission Reductions:

The assumed emission abatement factor of 80 % is a conservative estimate, identical to minimum emission reduction factor as guaranteed by BASF SE as technology provider.

1.17 List of commercially sensitive information (if applicable):

- /CIA/ - Customer Invoice of gas analyzer from BASF SE Germany to SBPC (2008-11-14) (evidence for project ownership and monitoring plan)
- /COS/ - Catalyst (type O3-85 SS6 6mm extrudate) Order Sheet for the project by Shanghai BASF Polyurethane Co., Ltd. (2007-11-28) (evidence for project ownership)
- /CQC/ - Catalyst Quality Certificates (for Campaign 2008-03-12 to 2009-03-10)
- /DN/ - Delivery Notes of the catalyst supplier for the previous campaigns
- /DS/ - N₂O catalyst design sheet from BASF (for 85% abatement factor)
- /EIA/ - 1. Environmental Impact Assessment Outline on Sino-Foreign Joint Venture Integrated Isocyanates project, Shanghai (06/2000); 2. Environmental Impact Assessment Report on Sino-Foreign Joint Venture Integrated Isocyanates project (04/2001); 3. Sino-Foreign Joint Venture Shanghai Integrated Isocyanates Project Environmental Impact Report Supplement (11/2004)

- /FSR/ - 1. Pre-Feasibility Study Report on TMI project of SBPC (08/1999); 2. Pre-Feasibility Study Report of Sino-Foreign Joint Venture 160KT/A Crude MDI project (MDI) (08/1999); 3. Pre-Feasibility Study Summary Report of Sino-Foreign Joint Venture Shanghai Integrated Isocyanates project (08/1999), prepared by China International Chemical Consulting Corporation (evidence for the HNO₃ production capacity pre-design of 245,000 t/y); 4. Feasibility Study Summary Report of Sino-Foreign Joint Venture Shanghai Integrated Isocyanates projects (11/2001); 5. Feasibility Study Report of Sino-Foreign Joint Venture 160KT/A Crude MDI project (11/2001); 6. Shanghai BASF Polyurethane Company Limited Feasibility Study Report on TDI and MDI Project (11/2001); 7. Sino-Foreign Joint Venture Integrated Isocyanates Projects project design production capacity adjustment report (10/2003)
- /HPD/ - Historic performance data (e.g. ammonia production, operating temperatures, operating pressure, ammonia flow rate, air flow rate)
- /OM/ - Operating Manual, process description and operation control (evidence for cross check technical parameters, e.g., concentration 68%, etc.)
- /PCM/ - Preliminary result from Concentration Measurements prior to the baseline campaign (02/2009)
- /PI/ - P&I diagrams of the plant
- /PSAP/ - Time sheets on planning hours, in SAP system (evidence for project planning since 1998)
- /UTB/ - Evidence for internal management decision
- /XCS/ - Emission reduction excel calculation sheets
- Documentation on plant history (available to validator at onsite visit)
- Documentation on gauze supplier (available to validator at onsite visit)
- Documentation on gauze composition (available to validator at onsite visit)
- Catalyst quality certificate
- List of confidential parameters

2 VCS Methodology:

2.1 Title and reference of the VCS methodology applied to the project activity and explanation of methodology choices:

The project at hand applies CDM-EB approved baseline and monitoring methodology AM0034, Version 3.2, "Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants".

In compliance with AM0034, for baseline identification prescribed procedures of approved methodology AM0028 VER 4.1 "Catalytic N₂O destruction in the tail gas of Nitric Acid Plants" are applied.

Also along AM0034 requirements the "Tool for demonstration and assessment of additionality", agreed by the Executive Board, is applied.

2.2 Justification of the choice of the methodology and why it is applicable to the project activity:

In compliance with AM0034, the project intends the installation of a secondary N₂O abatement catalyst inside the ammonia burner of a nitric acid plant, underneath the precious metal gauze pack.

With regard to the methodology applied all applicability criteria with just one exception are fulfilled:

- The project activity does not affect the level of nitric acid production;
- The project will not lead to the shut down of any existing N₂O destruction or abatement facility or equipment in the plant
- There are currently no regulatory requirements or incentives to reduce levels of N₂O emissions from nitric acid plants in the host country;
- The project activity will not increase NO_x emissions;
- The project will not lead to any additional emissions of greenhouse gases, either directly or indirectly as there is neither additional energy consumption, raw material consumption (ammonia, air, water), nor leakage generated by the project.
- NO_x abatement catalyst installed prior to start of project activity is not a Non-Selective Catalytic Reduction (NSCR) DeNO_x unit.
- Continuous real-time measurements of N₂O concentration and total gas volume flow is guaranteed as monitoring equipment will be operational and used in accordance with EN 14181 for the baseline campaign as well as thereafter throughout the whole crediting period of the project activity

The single deviation from AM0034 applicability criteria concerns the fact the Caojing N₂O destruction measure is to be conducted at a facility which started commercial production later than 31 December 2005. Why this deviation is adequate and well justified has been described above in detail (cf. 1.12).

According to paragraph 5.3 of the VCS standard a project specific deviation is permissible as long as the conservativeness of the baseline scenario, the additionality determination and the project GHG inclusion is not negatively affected.

2.3 Identifying GHG sources, sinks and reservoirs for the baseline scenario and for the project:

Figure 6 below illustrates the project boundary of the project activity. The spatial extent of the project boundary covers the nitric acid production facility and equipments for the complete nitric acid production process, from the inlet to the ammonia burner to the stack; all compressors and tail gas expander turbines are also included.

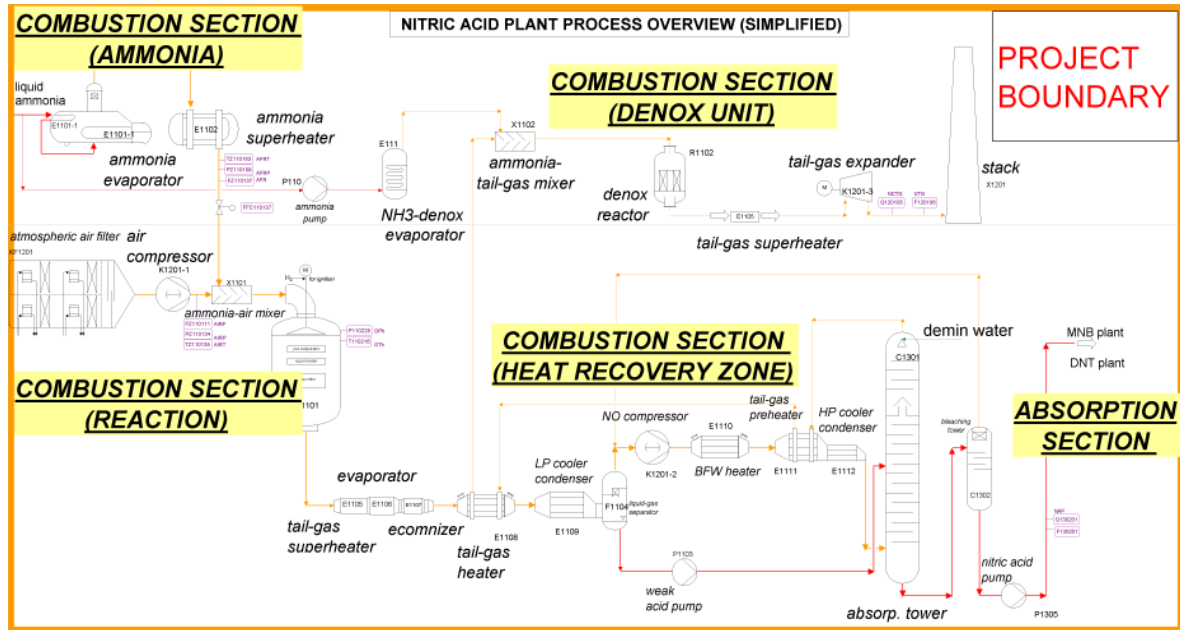


Figure 6: Plant specific flowchart indicating the project boundary

Table 2 below gives an overview of emission sources included or excluded from the project boundary. The only greenhouse gas to be included in the project boundary is the N_2O contained in the tail gas.

	Source	Gas	Included?	Justification
Baseline	Nitric Acid Plant (Burner Inlet to Stack)	CO_2	Excluded	The project does not lead to any change in CO_2 or CH_4 emissions, therefore these are not included.
		CH_4	Excluded	
		N_2O	Included	
Project Activity	Nitric Acid Plant (Burner Inlet to Stack)	CO_2	Excluded	The project does not lead to any change in CO_2 or CH_4 emissions
		CH_4	Excluded	
		N_2O	Included	
	Leakage emissions from production, transport, operation and decommissioning of the catalyst	CO_2	Excluded	No leakage emissions are expected.
		CH_4	Excluded	
		N_2O	Excluded	

Table 2: Overview of emission sources included or excluded from the project boundary

2.4 Description of how the baseline scenario is identified and description of the identified baseline scenario:

As required by AM0034 the identification of the baseline scenario follows the prescribed procedures (5-step approach) of approved methodology AM0028 VER 4.1 "Catalytic N₂O destruction in the tail gas of Nitric Acid Plants".

Step 1: Identification of technically feasible baseline scenario alternatives to the project activity

In compliance with AM0028 all technically feasible options which are realistic and credible are listed below and further discussed in the subsequent steps.

Step 1a: N₂O destruction or abatement alternatives

The theoretical alternatives to the project are:

- (a) Continuation of status quo (plant with no N₂O abatement facility)
- (b) Utilization of N₂O after recycling as feedstock for the plant or for other external uses
- (c) Installation of N₂O tertiary destruction technology
- (d) Installation of non-Selective Catalytic Reduction (NSCR) DeNO_x unit
- (e) Installation of primary or secondary measures for N₂O
- (f) Switch to alternative production method with no ammonia oxidation process

Step 1b: NO_x destruction alternatives

The theoretical alternatives to the project are:

- (g) The continuation of the status quo with one installed Selective Catalytic Reaction (SCR) unit
- (h) Installation of new SCR DeNO_x unit
- (i) Installation of new tertiary destruction technology that combines NO_x and N₂O destruction
- (j) Installation of Non-Selective Catalytic Reduction (NSCR) DeNO_x facility (=d)

With an SCR already installed and thus fulfilling all existing NO_x requirements, the installation of a SCR unit cannot be regarded as a reasonable option. For that reason a SCR scenario shall not be included in the list of feasible baseline scenario alternatives. This is further explained below in step 2.

Step 2: Elimination of baseline alternatives that do not comply with legal or regulatory requirements

All alternatives comply with applicable laws and regulations.

Regarding N₂O emissions there are no national regulations or legal obligations at the moment in China. Given the conclusion of China's

National Climate Change Program released in June of 2007,⁶ it is unlikely that any such limits on N₂O emissions will be imposed in the near future.

Regarding NO_x emissions the respective Chinese law is the "Integrated emission standard of air pollutants GB16297-1996". For not exceeding its defined threshold value of 105.5 mg/m³ and even stricter plant specific threshold values (50 mg/m³) specially imposed for joint ventures, SBPC operates a DeNO_x SCR facility.

Thus all alternatives comply with national regulations and requirements. No alternative can be eliminated in this step.

Step 3: Elimination of baseline alternatives that face prohibitive barriers (barrier analysis)

Sub-step 3a and 3b:

The following baseline scenarios have to be excluded for general technical or economical reasons:

(b) Alternative use of N₂O at Caojing plant is neither technologically nor economically feasible. Neither in China nor anywhere else in the world its application has been technically proven or implemented.⁷

(f) Nitric acid production in industrial facilities such as Caojing plant generally cannot be conducted without usage of ammonia oxidation process.

(i) An alternative installation of a new tertiary NO_x and N₂O destruction technology has yet to be proven. So long, no such installations have appeared on the market. Therefore this scenario shall be excluded because of technological barriers.

Thus only the five alternatives below do not face prohibitive barriers:

- (c) Tertiary abatement technology for combined NO_x and N₂O destruction
- (d/j) NSCR
- (e) Secondary N₂O abatement technology
- (g) Status quo
- (h) Installation of new SCR DeNO_x unit

⁶ NDRC (2007). China's National Climate Change Programme. National Development and Reform Commission (NDRC) of People's Republic of China, available for download at http://assets.panda.org/downloads/chinas_national_climate_change_programme_en.pdf.

⁷ EU (2006). JRC. Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals-Ammonia, Acids and Fertilizers. Directorate-General Joint Research Centre (JRC), Institute for Prospective Technological Studies, European Commission, Seville, Spain; December 2006 (available for download at <http://eippcb.jrc.es/reference/>).

Step 4: Identification of most economically attractive baseline scenario alternative

4a: Determination of appropriate analysis method

None of the remaining project alternatives generates any financial or economic benefits (other than VCS related income). For this reason simple cost analysis is applied here.

4b: Option I: Apply simple cost analysis

(h) With an SCR DeNO_x unit installed (including the 56 m high stack), all current NO_x emission requirements are fulfilled. For this reason the installation of a second NO_x installation cannot be regarded as a reasonable scenario.

(c;d/j;e) All remaining options for N₂O destruction (including the project scenario e) also require substantive investments while none of them generates any profit.

On the other side the continuation of the status quo (scenario g) is cost-neutral, thus economically speaking the most attractive scenario. Therefore we conclude the continuation of the status quo is the baseline scenario for the project.

Step 5: Re-assessment of Baseline Scenario in course of proposed project activity's lifetime

Step 5a:

Currently all NO_x emission standards are met. An adjustment of or amendment to current regulations concerning NO_x emission limits shall automatically lead to a re-assessment of the baseline scenario and the respective emission factor.

Step 5b:

In case of introduction of either concentration or mass limits on N₂O emissions, the baseline scenario would be re-assessed as prescribed in AM0034 (cf. AM0034, p.7, "Impact of regulations")

2.5 Description of how the emissions of GHG by source in baseline scenario are reduced below those that would have occurred in the absence of the project activity (assessment and demonstration of additionality):

For the demonstration of additionality, AM0034 refers to the latest version of the "Tool for demonstration and assessment of additionality" agreed by the Executive Board.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

For the application of step 1 of the "Tool for demonstration and assessment of additionality" please refer to baseline scenario

determination above (2.4). In compliance with AM0034 this step is being omitted here.

Step 2: Investment Analysis

Sub-step 2a. Appropriate analysis method

The project activity will reduce N₂O emissions inside the ammonia burner by installing a secondary catalyst in the burner basket located beneath the ammonia oxidation gauzes. The project activity generates no income besides the revenue from the certificates. In the absence of such income its realization is economically not feasible. As the project does not generate any financial or economic benefits, simple cost analysis (option I) is applied.

Sub-step 2b: Simple Cost Analysis (Option I)

The costs for the proposed project activity consist of the investment needed for the plant modifications and the repeating expenditures for the catalyst fillings (the catalyst has to be renewed around every two years). The specific costs for the catalyst shall not be disclosed here for confidentiality reasons. However, according to the BREF, catalytic N₂O decomposition in the oxidation reactor leads to additional production costs of some 0.98 to 1.20 EUR per tonne HNO₃ produced.⁸ Calculating with costs of 1 Euro, annual expenses would reach up to 265,000 Euro (plant production capacity). The N₂O abatement does not lead to any economic benefits (other than via the VCUUs) which could compensate for the investment.

Thus, when compared to the identified baseline scenario (cost neutrality), the proposed project activity is financially not attractive. As the proposed project activity is more costly than the baseline alternative, we directly proceed to Step 4.

Step 4. Common practice analysis

The common practice analysis is a credibility check to complement the investment analysis (Step 2) or barrier analysis (Step 3) with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region.

Sub-step 4a: Analysis of other activities similar to the project activity

N₂O generated at current emission levels in nitric acid plants does not have any economic value, nor is it a toxic or damaging substance to human beings. Therefore, most countries do not have regulations or incentives to eliminate N₂O emissions for nitric acid plants. Some studies from the first years of this decade have shown that N₂O abatement technologies just recently had not yet spread out into the nitric acid industry, not even in Annex I countries, except for initial industrial trials (EFMA⁹, IPCC¹⁰, US EPA¹¹). The driving force

⁸ See BREF document for LVIC, European Commission, 2006, p. 125.

⁹ See European Fertilizer Manufacturers (EFMA): "The European Fertilizer Manufacturers' Position on the European Commission's Proposal for a Directive on EU Emissions Trading", March 2005. P.1; and European Fertilizers Manufacturers Association (EFMA): Best Available Techniques for

to develop the technology and to conduct trials for secondary N₂O abatement catalysts is actually based on the general expectation that some industrialized country governments, e.g. the EU, USA, Canada and Japan, may eventually introduce caps on N₂O emissions from large point sources such as nitric acid plants.

In China, like in most other countries, there is no regulation or incentive to eliminate N₂O emissions for nitric acid plants. Consequently, the current situation for the nitric acid industry in the host country is that accruing N₂O gases are directly released to the atmosphere as an unwanted by-product. Only recently first project activities similar to the one at hand have emerged. Those are all financed via the CDM mechanism.

Sub-step 4b: Discussion of similar Options that are occurring

No similar activities have been carried out in the China without the use of CDM. Many plants with similar processes in China are considering, preparing or already implementing CDM projects. In conclusion, the continuation of the current situation is considered as the baseline scenario and therefore the proposed VCS project activity is additional.

In case of a reassessment of the Baseline Scenario during the lifetime of the proposed project activity (cf. step 5 of 2.4) the additionality shall be re-proven also.

Pollution Prevention and Control in the European Fertilizer Industry (Booklet No. 2 of 8) "Production of Nitric Acid", 2000. p.21.

¹⁰ Integrated Pollution Prevention and Control (IPPC): "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories - N₂O Emissions from Adipic Acid and Nitric Acid Production". Author Heike Mainhardt, ICF Inc, 2000. p184.

¹¹ U.S. Adipic Acid and Nitric Acid N₂O Emissions 1990-2020: Inventories, Projections and Opportunities for Reductions, US EPA, November 2001. p.5.

3 Monitoring:

3.1 Title and reference of the VCS methodology (which includes the monitoring requirements) applied to the project activity and explanation of methodology choices:

The project utilizes the following CDM EB-approved methodologies:

- AM0034, VER 3.2 "Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants"
- AM0028 VER 4.1 "Catalytic N₂O destruction in the tail gas of Nitric Acid Plants"

3.2 Monitoring, including estimation, modelling, measurement or calculation approaches:

Monitoring is carried out along AM0034 stipulations. It serves the data control/logging and the consecutive calculation of baseline and project emissions and thus the calculation of achieved emission reductions. Monitored parameters are noted down in 3.3. The origin of parameters is shown in the respective tables below where also QA/QC procedures are indicated.

The following performance characteristics and performance control procedures apply to the monitoring system:

Parameter and ID number	UNC level of data (high/medium/low)	QA/QC procedures planned for data, or why such procedures are not necessary.
P.1 NCTG	Low	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181). This standard does especially require regular checks and calibrations within the QAL 2 (Level 2 Quality Assurance Test, every three years) and AST (Annual Surveillance Test) procedures by an independent third party. The continuous quality assurance (QAL3) will be implemented. Staff will be trained in monitoring procedures and a reliable technical support infrastructure will be set up.
P.2 VTG	Low	Same as for P.1.
P.4 NAP	Low	Regular calibrations according to vendor specifications and recognised industry standards.
P.5 TTG	Low	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181).
P.5 PTG	Low	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181).
B.1 NCTG	Low	Same as for P.1.
B.2 VTG	Low	Same as for P.1.
B.3 OH	Low	Included in evaluation by third party validator.
B.4 NAP	Low	Regular calibrations according to vendor specifications and recognised industry standards.
B.5 TTG	Low	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181).

B.6 PTG	Low	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181).
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Table 3: Performance characteristics and control of monitoring system

Project related monitoring procedures begin with the initiation of the baseline measurements. The responsibilities and management structure follows standard integrated Management System norms ISO 9001/14001 and 18001. The exact responsibilities for monitoring will be defined in the monitoring plan (as also included in the monitoring report) and other relevant plant operation guidebooks where accordant procedures will be amended or referred to. The general responsibility structure for plant operation is shown in figure 8 below (cf. 3.4).

3.3 Data and parameters monitored / Selecting relevant GHG sources, sinks and reservoirs for monitoring or estimating GHG emissions and removals:

The following parameters are available at validation:

Data / Parameter:	GS _{normal}
Data unit:	
Description:	Normal gauze supplier for historical campaigns
Source of data to be used:	Delivery notes
Value of data applied for the purpose of calculating expected emission reductions	-
Description of measurement methods and procedures to be applied:	To be obtained from historic campaigns. The information will be stored in electronic records and paper for at least 2 years.
QA/QC procedures to be applied:	
Any comment:	The information is confidential and will only be available at the plant for determination and verification procedures.

Data / Parameter:	GC _{normal}
Data unit:	
Description:	Gauze composition during historical campaigns
Source of data to be used:	Delivery notes/data provided by supplier
Value of data applied for the purpose of calculating expected emission reductions	-
Description of measurement methods and procedures to be applied:	To be obtained during recent campaigns. The information will be stored in electronic records and paper for at least 2 years.
QA/QC procedures to be applied:	
Any comment:	The information is confidential and will only be available at the plant for determination and verification

	procedures.
Data / Parameter:	CL _{normal}
Data unit:	tHNO ₃
Description:	Normal campaign length
Source of data to be used:	Production log
Value of data applied for the purpose of calculating expected emission reductions	169,991.83
Description of measurement methods and procedures to be applied:	Average value, calculated from nitric acid production data during preceding two campaigns.
QA/QC procedures to be applied:	
Any comment:	Average historical campaign length during two operating condition campaigns (of three in total). The first production campaign was not included as it is not representative regarding normal operation. This is due to inappropriate installation of the gauzes (upside-down).

The following parameters serve for the determination of the permitted operating conditions:

For determination of AFR_{max}, AAR_{max} and OT_{normal} AM0034 option a (historical values) has been applied. As for OP_{normal} such historical values were not available, option b (direct reference to manual data) has been applied here.

Data / Parameter:	AFR _{max}
Data unit:	t/h
Description:	Maximum Ammonia gas flow rate to the AOR
Source of data to be used:	Operating manual (for 110% load)
Value of data applied for the purpose of calculating expected emission reductions	11.250
Description of measurement methods and procedures to be applied:	From historical operating conditions a maximum value (11.519) is derived. This value is higher than the value indicated in the operating manual. Accordingly the manual value is applied.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	AAR _{max}
Data unit:	Vol-%
Description:	Maximum ammonia to air ratio
Source of data to be used:	Conservative practical value
Value of data applied for the purpose of calculating expected emission reductions	11.35
Description of measurement methods and procedures to be applied:	For determination of this parameter historical values have been applied.

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applied:	
QA/QC procedures to be applied:	
Any comment:	The historical maximum (11.93) is higher than the manual indication (11.6). Nevertheless for practical reasons the range of operation shall be limited here to an even lower value.

Data / Parameter:	OT _{normal}
Data unit:	°C
Description:	Normal range of oxidation temperature
Source of data to be used:	Historical campaigns
Value of data applied for the purpose of calculating expected emission reductions	857,836 - 875,602
Description of measurement methods and procedures to be applied:	This value range lies within the max/min range defined by the manual (830-900).
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	OP _{normal}
Data unit:	MPa
Description:	Normal range of oxidation pressure
Source of data to be used:	Operating manual
Value of data applied for the purpose of calculating expected emission reductions	0.28 - 0.45 MPa
Description of measurement methods and procedures to be applied:	There are no records available. In the absence of historical data this value has been taken from the plant's operating manual.
QA/QC procedures to be applied:	
Any comment:	

The following parameters are to be monitored during baseline campaign:

Data / Parameter:	B.1 NCTG _{BC}
Data unit:	mg N ₂ O /Nm ³ (converted from ppmv)
Description:	N ₂ O concentration in tail gas during baseline campaign
Source of data to be used:	N ₂ O analyzer
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Measured every 2 seconds. The data output from the analyzer will be processed using appropriate software. The information will be stored in electronic records and paper for the entire crediting period.
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181). Staff will be trained in monitoring procedures and a reliable technical support infrastructure will set up.
Any comment:	

Data / Parameter:	B.2 VTG _{BC}
Data unit:	Nm ³ / h
Description:	Normal gas volume flow rate of tail gas during baseline campaign
Source of data to be used:	Gas volume flow meter
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	The information will be stored in electronic records and paper for the entire crediting period. The data output from the stack flow meter will be processed using appropriate software.
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181). Staff will be trained in monitoring procedures and a reliable technical support infrastructure will set up.
Any comment:	

Data / Parameter:	B.3 OH _{BC}
Data unit:	Hours
Description:	Operating hours during baseline campaign
Source of data to be used:	Production log
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Plant manager records the hours of full operation of the plant during the baseline campaign. To be determined during baseline campaign.

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	The information will be stored in electronic records and paper for the entire crediting period
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	B.4 NAP _{BC}
Data unit:	tHNO ₃
Description:	Nitric acid production (100% concentrate)
Source of data to be used:	
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Continuously monitored and compiled for entire baseline campaign. The information will be stored in electronic records and paper for the entire crediting period.
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognised industry standards.
Any comment:	

Data / Parameter:	B.5 TTG _{BC}
Data unit:	°C
Description:	Temperature of tail gas during baseline campaign
Source of data to be used:	Thermometer
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Every 2 seconds. The information will be stored in electronic records and paper for at least 2 years.
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181). Staff will be trained in monitoring procedures and a reliable technical support infrastructure will set up.
Any comment:	

Data / Parameter:	B.6 PTG _{BC}
Data unit:	Pa
Description:	Pressure of tail gas during baseline campaign
Source of data to be used:	Metering
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Every 2 seconds. The information will be stored in electronic records and paper for at least 2 years.
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognised

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	industry standards (EN 14181). Staff will be trained in monitoring procedures and a reliable technical support infrastructure will set up.
Any comment:	

Data / Parameter:	B.7 UNC
Data unit:	%
Description:	Overall measurement uncertainty of monitoring system
Source of data to be used:	Calculation of the combined uncertainty of applied monitoring equipment
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Once after monitoring system has been commissioned. This information will be stored in electronic records and paper during the entire project activity.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	B.8 AFR _{BC}
Data unit:	kg/h
Description:	Ammonia gas flow rate during baseline campaign
Source of data to be used:	Flow meters
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Continuous measurement.
QA/QC procedures to be applied:	The information will be stored in electronic records and paper for at least 2 years.
Any comment:	

Data / Parameter:	B.9 AAR _{BC}
Data unit:	Vol.-%
Description:	Ammonia to air ratio during baseline campaign
Source of data to be used:	Flow meters
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Continuous measurement (every hour) The information will be stored in electronic and paper for at least 2 years.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	B.10 OT _h
Data unit:	°C
Description:	Oxidation temperature for each hour

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Source of data to be used:	
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	To be obtained during baseline campaign.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	B.11 OP_h
Data unit:	Pa
Description:	Oxidation pressure for each hour
Source of data to be used:	
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	To be obtained during baseline campaign.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	B.12 GS_{BL}
Data unit:	
Description:	Gauze supplier for the baseline campaign
Source of data to be used:	Delivery note
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	To be obtained during baseline campaign. Information will be stored in electronic records and paper for the crediting period.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	B.13 GC_{BL}
Data unit:	
Description:	Gauze composition during baseline campaign
Source of data to be used:	Delivery notes
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	To be obtained during baseline campaign. Information will be stored in electronic records and paper for the crediting period.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	B.14 EF_{reg}
Data unit:	
Description:	Changed emission level set by

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	changed policies or regulations.
Source of data to be used:	Monitored
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Updated when new regulations come into force.
QA/QC procedures to be applied:	
Any comment:	

The following parameters are to be monitored during the project campaigns:

Data / Parameter:	P.1 NCTG
Data unit:	mg N ₂ O /Nm ³ (concerted from ppmv)
Description:	N ₂ O concentration in tail gas
Source of data to be used:	N ₂ O analyzer
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Every 2 seconds. The data output from the analyzer will be processed using appropriate software program. The information will be stored in electronic records and paper for at least 2 years.
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognized industry standards (EN 14181). Staff will be trained in monitoring procedures and a reliable technical support infrastructure will set up.
Any comment:	

Data / Parameter:	P.2 VTG
Data unit:	Nm ³ /h
Description:	Volume flow rate of tail gas
Source of data to be used:	Gas volume flow meter
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Every 2 seconds. The data output from the stack flow meter will be processed using appropriate software. The information will be stored in electronic records and paper for at least 2 years.
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181). Staff will be trained in monitoring procedures and a reliable technical support infrastructure will set up.
Any comment:	

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Data / Parameter:	P.3 OH
Data unit:	Hours
Description:	Operating Hours
Source of data to be used:	Production log
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Daily, compiled for entire campaign. Plant manager records the hours of full operation of the plant during a campaign. The information will be stored in electronic records and paper for at least 2 years.
QA/QC procedures to be applied:	Included in evaluation by third party validator
Any comment:	

Data / Parameter:	P.4 NAP
Data unit:	tHNO ₃
Description:	Nitric Acid production (100% concentrate)
Source of data to be used:	Production log
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Daily, compiled for entire campaign. The information will be stored in electronic records and paper for at least 2 years.
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognised industry standards.
Any comment:	

Data / Parameter:	P.5 TTG
Data unit:	°C
Description:	Temperature of tail gas
Source of data to be used:	Thermometer
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Every 2 seconds. The information will be stored in electronic records and paper for at least 2 Years.
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181). Staff will be trained in monitoring procedures and a reliable technical support infrastructure will set up.
Any comment:	

Data / Parameter:	P.6 PTG
Data unit:	Pa
Description:	Pressure of tail gas
Source of data to be used:	Metering

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Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Every 2 seconds. The information will be stored in electronic records and paper for at least 2 years.
QA/QC procedures to be applied:	Regular calibrations according to vendor specifications and recognised industry standards (EN 14181). Staff will be trained in monitoring procedures and a reliable technical support infrastructure will set up.
Any comment:	The information will be stored in electronic records and paper for at least 2 years.

Data / Parameter:	P.7 GS _{project}
Data unit:	
Description:	Gauze supplier for the project campaigns
Source of data to be used:	Delivery note/gauze supplier's information
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	To be obtained during each project campaign. The information will be stored in electronic records and paper for the crediting period.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	P.8 GC _{project}
Data unit:	
Description:	Gauze composition during baseline campaign
Source of data to be used:	Delivery note/gauze supplier's information
Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	To be obtained during the project campaign. The information will be stored in electronic records and paper for the crediting period.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	P.9 EF _{reg}
Data unit:	
Description:	Changed emission level set by changed policies or regulations.
Source of data to be used:	Monitored

Value of data applied for the purpose of calculating expected emission reductions	
Description of measurement methods and procedures to be applied:	Updated when new regulations come into force.
QA/QC procedures to be applied:	
Any comment:	

Data / Parameter:	P.10 GWP _{N₂O, CDM, 2013}
Data unit:	
Description:	Consideration of an adjusted GWP regulations, according to relevant CDM stipulations in the course of verifications from 2013 onwards.
Source of data to be used:	Monitored
Value of data applied for the purpose of calculating expected emission reductions	310
Description of measurement methods and procedures to be applied:	Updated when new regulations come into force.
QA/QC procedures to be applied:	
Any comment:	

3.4 Description of the monitoring plan

The procedure for the proposed project does basically follow the official methodology AM0034, VERSION 3.2, which contains both a baseline and a monitoring methodology.

An automated measuring system (AMS) will be installed using European norm EN 14181 as guidance for its selection, installation, and operation. Thus three different levels of quality assurance tests and one annual functional test for the AMS shall be applied; The AMS together with the procedures for its uncertainty determination fulfil DIN EN ISO 14956 requirements.

The AMS will provide separate readings for N₂O concentration and gas volume flow continuously, generating average values for every 60 minutes of operation. Error readings (e.g. downtime or malfunction) and extreme values are automatically eliminated from the output data series by the monitoring system. Besides these two parameters, the temperature and pressure of the tail gas are recorded in the AMS.

Statistical evaluation will be applied to the project data series for N₂O concentration and gas volume flow in order to eliminate mavericks from downtime or malfunction of the monitoring system.

Detailed information pertaining to the monitoring plan are the following:

Operational procedures: quality assurance responsibilities

The operational procedures regarding management structure, responsibilities and training implemented at the nitric acid plant

fulfill standard Integrated Management System norms ISO 9001/14001 and 18001. The respective instructions will be amended for project specific stipulations.

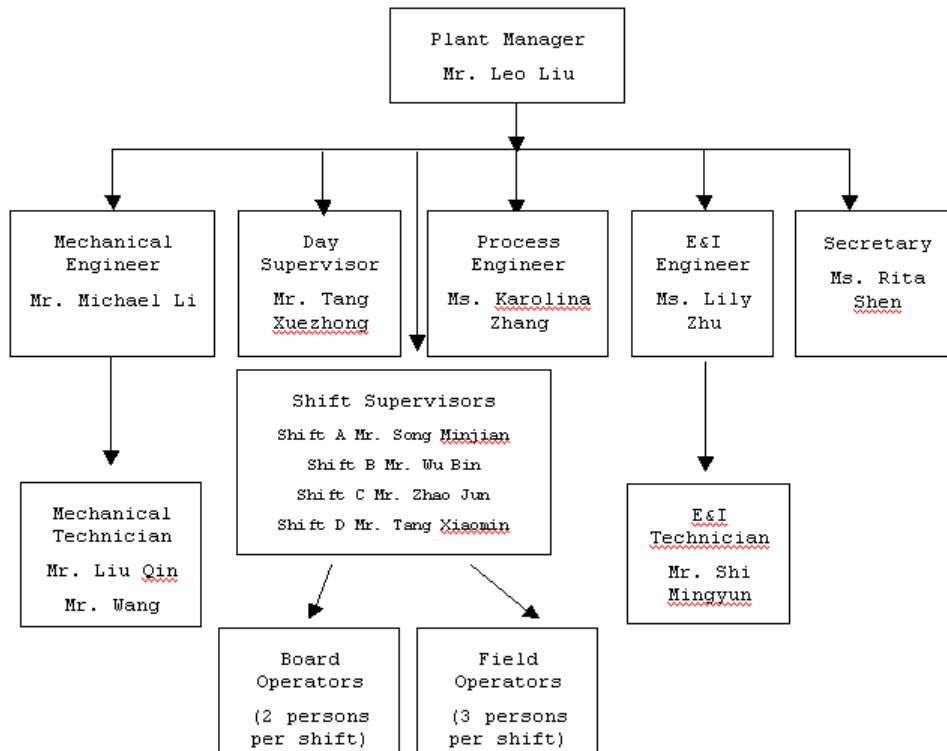


Figure 8: Description of relation between plant management and plant operational structure

Training

In order to ensure a reliable and transparent implementation of the monitoring plan, all staff which is in charge of tasks connected to data acquisition for the monitoring will be trained and instructed accordingly. A first training on the VCS project was conducted in August 2008. Maintenance and monitoring procedures to the VCS project will be taken account of in future training plans.

At the time of PD writing, a detailed concept with the designation of tasks has yet to be elaborated. This will be done in the form of an internal "VCS handbook". It shall contain measurement, data acquisition, maintenance and quality assurance procedures as well as a clear allocation of responsibilities and a training schedule for all plant staff with tasks that are connected to the VCS project.

Calculation of emission reductions

The calculation of the Emission Reductions is done after each campaign by the Nitric Acid Plant Technologist or Technology Specialist, based on the campaign data, and validated by the Nitric Acid Plant Manager. SBPC is responsible for the declaration of the emission reductions, at a frequency to be fixed later in the project implementation.

The ex-ante emission factor of PD section 1.3 (7.5 kgN₂O/tHNO₃) is based on first measured data shortly before and during the first days of the baseline campaign. The uncertainty of the AMS (to be

discounted) is not considered in the figure as it is not known yet. Still first emission factor data from the analyser during baseline determination generally support the conservativeness of the assumption.

4 GHG Emission Reductions:

4.1 Explanation of methodological choice:

CDM approved methodology AM0034 was chosen as methodological basis. AM0034 defines well established procedures and has already been successfully applied to several CDM and JI projects.

Methodology AM0034, VERSION 3.2, defines procedures for calculation of baseline emissions, project emissions, leakage and emission reductions. All relevant information on this is presented in the following three chapters.

4.2 Quantifying GHG emissions and/or removals for the baseline scenario:

The baseline shall be established through continuous monitoring of both N₂O concentration and gas volume flow in the tail gas of the nitric acid plant for one complete campaign prior to project implementation, considering the following steps aiming at avoiding overestimation of the resulting baseline emission factor.

Determination of the permitted operating conditions of the nitric acid plant to avoid over-estimation of baseline emissions

As per AM0034 in order to guarantee that there is no bias in the baseline value by establishment of special operating conditions during baseline measurements, the normal ranges of operation are to be determined and their compliance during measurements is to be controlled.

In general normal operating conditions shall be obtained from historical campaigns; furthermore these values are to be crosschecked with permitted ranges as defined in the plant's operating manual. In the absence of historical data manual data shall define the normal value.

The controlled parameters concern the following data:

- (i) oxidation temperature
- (ii) oxidation pressure
- (iii) ammonia gas flow rate
- (iv) ammonia air ratio

Oxidation temperature and pressure

The value range of the plant's normal oxidation temperature (OT) is derived from historical data, using the statistical analysis as per AM0034.

The value range of normal oxidation pressure (OP) is directly taken from the operating manual as for this no records from historical campaigns are available.

All (historical and manual) values are available for validation and thus included in this PD (cf. 3.3 above).

Ammonia gas flow rates and ammonia to air ratio input into the ammonia oxidation reactor (AOR)

The maximum value of the ammonia gas flow rate to the ammonia oxidation reactor (AFR_{max}) is taken from the operating manual. The maximum ammonia to air ratio (AAR_{max}) is a conservative practical value.

Both values are available for validation and thus included in this PD. For further explanation on the values see 3.3 above.

Determination of baseline emission factor

In compliance with AM0034, baseline emission factors will be calculated using AMS (Automated Measuring System, meeting EN 14181 standard) data of N_2O concentration and tail gas volume flow during the baseline measurement period. The monitoring system provides 2-second data for the two parameters for a defined period of time. Error readings (e.g. downtime or malfunction) and extreme values will be automatically eliminated from the output data series by the monitoring system.

To exclude distortion by data mavericks and to guarantee conservativeness, the data series will be statistically evaluated. The statistical procedure will be applied to data obtained after eliminating data measured from periods in which the plant operated outside the permitted ranges. The following statistical evaluation will apply to both N_2O concentration and gas volume flow:

- a) Calculation of sample mean ($\bar{x}$)
- b) Calculation of sample standard deviation (s)
- c) Calculation of 95 % confidence interval (equal to 1.96 times the standard deviation)
- d) Elimination of all data that lie outside the 95 % confidence interval
- e) Calculation of new sample mean from the remaining values (volume of tail gas (VTG) and N_2O concentration of tail gas (NCTG))

The average mass of N_2O emissions per hour is estimated as product of the NCTG and VTG. The N_2O emissions per period are estimates product of N_2O emission per hour and the total number of complete hours of the period using the following equation:

$$BE_{BC} = VTG_{BC} \times NCTG_{BC} \times OH_{BC} \times 10^{-9} \quad \text{Formula 1}$$

Where:

BE_{BC}	Total N_2O emissions during the baseline measurement campaign (t N_2O)
$NCTG_{BC}$	Mean concentration of N_2O in the tail gas during the baseline measurement campaign (mg N_2O /Nm ³)
OH_{BC}	Operating hours of the baseline monitoring campaign (h)
VTG_{BC}	Mean gas volume flow rate of tail gas in the baseline measurement campaign (Nm ³ /h)

The baseline emission factor representing the average N_2O emissions per tonne of nitric acid over one full period is derived by dividing the total mass of N_2O emissions by the total output of 100%

concentrated nitric acid for that period. The overall uncertainty of the monitoring system shall also be determined and the measurement error will be expressed as a percentage (UNC). The N₂O emission factor per tonne of nitric acid produced in the baseline period (EF_{BL}) shall then be reduced by the estimated percentage error as follows:

$$EF_{BL} = \frac{BE_{BC}}{NAP_{BC}} \times \left(1 - \frac{UNC}{100} \right) \quad \text{Formula 2}$$

Where:

EF _{BL}	Baseline N ₂ O emission factor (tN ₂ O/tHNO ₃)
NAP _{BC}	Nitric acid production during the baseline campaign (tHNO ₃)
UNC	Overall uncertainty of the monitoring system (%), calculated as the combined uncertainty of the applied monitoring equipment

The baseline measurements are not valid and have to be repeated if the plant operates outside of the permitted range for more than 50% of the duration of the baseline campaign.

Impact of regulations

In the absence of any national or regional regulations for N₂O emissions, the resulting EF_{BL} will be used as the baseline emission factor. In case of new regulations limiting N₂O emissions of the Caojing plant, no matter whether set through

- absolute emission caps,
- relative limits in relation to unit of output or
- threshold values for specific N₂O mass flow in the stack,

the baseline factor to the project (EF_{BL}) is always to be compared with the new plant specific emission factor that will be derived from the new regulatory level (EF_{reg}).

If the regulatory level is lower than the baseline factor determined for the project, the regulatory limit shall serve as the new baseline emission factor (EF_{reg}), that is:

If EF_{BL} > EF_{reg} the baseline N₂O emission factor shall be EF_{reg} for all calculations. EF_{reg} is the emission limit set by newly introduced policies or regulations (kgN₂O /tHNO₃).

The concrete derivation procedure is described in approved methodology AM0034. If the regulation based factor is lower than the baseline factor determined for the project, the regulatory limit shall serve as the new baseline factor. Observing the development of applicable regulations is part of the monitoring.

Composition of the ammonia oxidation catalyst

SBPC will control the composition of the Ammonia Catalyst. A long-term contract with a single gauze supplier underlines this. Thus the respective AM0034 stipulations will be fulfilled. As the composition of the catalyst used during the baseline measurement campaign (GC_{BL}) is identical to the ones of the preceding historical campaigns, no limitations to N₂O baseline emissions have to be considered.

In general the final choice of the different precious metals' share for the gauze to be employed in does mainly depend on the accordant purchase prices and optimization potentials to increase the NO yield from the ammonia oxidation. Thus slight variations in gauze composition may occur in the future. A minor variation of some 2 percent of the share of each element (e.g. platinum x% $\pm$ 2%) shall be possible in the future in order to allow for economically driven restrictions and technical optimization. The gauze composition applied at Caojing is proven to be common practice in the industry and it is in line with the specifications given in the IPPC BREF¹².

Campaign length

AM0034 specifies: „In order to take into account the variations in campaign length and its influence on N₂O emission levels, the historic campaign lengths and the baseline campaign length are to be determined and compared to the project campaign length“. The planned project activity will control this influence accordingly.

- Normal campaign length (CL_{normal})

Two of the so far three historic campaigns will be used to define the plant's operating conditions and set a justified cap on the length of the baseline campaign. The first campaign shall be excluded from this as it is not representative for a normal campaign.

- Baseline campaign length (CL_{BL})

The baseline campaign length is geared to the historic campaign length. As AM0034 specifies, it shall be treated as follows:

If CL_{BL} $\leq$ CL_{normal} all values measured during the baseline campaign will be used for the calculation of EF_{BL} (subject to the elimination of data that was monitored during times where the plant was operating outside of the "permitted range").

If CL_{BL} > CL_{normal} N₂O values that were measured beyond the length of CL_{normal} during the production of the quantity of nitric acid (i.e. the final tonnes produced) are to be eliminated from the calculation of EF_{BL}.

4.3 Quantifying GHG emissions and/or removals for the project:

Over the duration of the project activity, N₂O concentration and gas volume flow in the tail gas of the nitric acid plant as well as the temperature and pressure of ammonia gas flow and ammonia-to-air ratio will be measured continuously.

Estimation of campaign-specific project emissions

The monitoring system is to be installed using European norm EN 14181 and will provide separate readings for N₂O concentration and gas

¹² Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic chemicals, European Commission, December 2006, pages 96/97 and 110.

volume flow for a defined period of time (every hour of operation, i.e. an average of the measuring values of the past 60 minutes). Error readings (e.g. downtime or malfunction) and extreme values are automatically eliminated from the output data series by the monitoring system. Subsequently, the same statistical evaluation that has been applied to the baseline data series is to be applied to the project data series:

- a) Calculation of sample mean (x)
- b) Calculation of sample standard deviation (s)
- c) Calculation of 95 % confidence interval (equal to 1.96 times the standard deviation)
- d) Elimination of all data that lie outside the 95% confidence interval
- e) Calculation of new sample mean from the remaining values

Project emissions are determined by calculating the mean values for N₂O concentration and gas flow and multiply those with the number of operating hours. Statistical analysis will be applied to both N₂O concentration and gas volume flow.

Formula for the calculation of project emissions for a campaign:

$$PE_n = VTG \times NCTG \times OH \times 10^{-9} \quad \text{Formula 3}$$

Where:

PE _n	Total N ₂ O emissions for the nth project campaign (tN ₂ O)
VTG	Mean tail gas volume flow rate for the project campaign (m ³ /h)
NCTG	Mean concentration of N ₂ O in the tail gas for the project campaign (mgN ₂ O /m ³)
OH	Number of hours of operation in the specific project campaign (h)

From the project emissions and the accordant nitric acid production in the monitored campaign, the specific campaign emission factor is calculated:

$$EF_n = PE_n / NAP_n \quad \text{Formula 4}$$

Where:

EF _n	Project N ₂ O emission factor (tN ₂ O /tHNO ₃)
NAP _n	Nitric acid production during the project period (tHNO ₃)

All calculations will be carried out in an appropriate Excel file where all relevant values from the AMS and the process control system will be listed.

Derivation of a moving average emission factor

In order to take into account possible long-term emissions trends over the duration of the project activity and to take a conservative approach, a moving average emission factor (EF_{ma}) will be estimated. This procedure is conducted after every accomplished campaign (n).

If this emission factor is higher than the campaign specific factor, it shall also serve as the valid parameter for the calculation of emission reductions in the respective campaign. Otherwise the campaign specific factor shall serve for this purpose. This relation is expressed in the equation below:

$$EF_{ma,n} = (EF_1 + EF_2 + \dots + EF_n) / n \quad \text{Formula 5}$$

(tN₂O/HNO₃)

This process is repeated for each period so that a moving average is established over time, becoming more representative and precise with each additional period.

To calculate the total emission reductions achieved in a campaign in formula below, the higher of the two values EF_{ma} and EF_n shall be applied as the emission factor relevant for the particular campaign to be used to calculate emissions reductions (EF_p). Thus:

$$\begin{aligned} \text{If } EF_{ma,n} &> EF_n && \text{then } EF_p = EF_{ma} \\ \text{If } EF_{ma,n} &< EF_n && \text{then } EF_p = EF_n \end{aligned} \quad \text{Formula 6}$$

Where:

EF _n	Emission factor calculated for a specific project campaign n (tN ₂ O /HNO ₃)
EF _{ma,n}	Moving average emission factor after nth period, including the current period (tN ₂ O /HNO ₃)
n	Number of periods to date
EF _p	Emission factor that will be applied to calculate the emissions reductions from this specific period, i.e. the higher of EF _{ma,n} and EF _n (tN ₂ O /HNO ₃)

Minimum project emission factor

As an additional measure to guarantee the conservativeness of the calculation, a minimal emission factor is introduced.

By help of this emission factor (tN₂O /HNO₃) any potential long-term trend towards decreasing N₂O emissions that may result from a potential built up of platinum deposits shall be capped. After the first ten campaigns of the crediting period of the project, the lowest EF_n observed during those campaigns will be adopted as a minimum (EF_{min}). If any of the later project campaigns results in a EF_n that is lower than EF_{min}, the calculation of the emission reductions for that particular campaign shall use EF_{min} and not EF_n.

Downtime of Automated Measuring System

In the event that the monitoring system is down, the lowest between the conservative IPCC (4.5 kg N₂O/ton nitric acid) or the last measured value will be valid and applied for the downtime period for the baseline emission factor, and the highest measured value in the campaign will be applied for the downtime period for the campaign emission factor.

Leakage

No leakage emissions do accrue. A calculation is not required.

4.4 Quantifying GHG emission reductions and removal enhancements for the GHG project:

Emission reductions for the project activity over a specific project campaign are determined by deducting the campaign-specific emission factor (EF_n) from the baseline emission factor (EF_{BL}) and multiplying the result (a) by the production output of 100% concentrated nitric acid over that very campaign period and (b) by the GWP of N₂O:

$$ER = (EF_{BL} - EF_p) * NAP * GWP_{N_2O} \text{ (tCO}_2\text{e)} \quad \text{Formula 7}$$

Where:

ER	Emission reductions of the project for the specific campaign (tCO ₂ e)
NAP	Nitric acid production for the project campaign (tHNO ₃). The maximum value of NAP shall not exceed the design capacity.
EF_{BL}	Baseline emission factor
EF_p	Emission factor used to calculate the emissions from this particular period (i.e. the higher of $EF_{ma,n}$, EF_n and EF_{min})
GWP_{N_2O}	Global Warming Potential of N ₂ O: 310 / value applicable as per CDM stipulations valid as per 2013 and following years (cf. section 3.3, parameter 10).

5 Environmental Impact:

There is no legislative requirement for an environmental impact assessment.

The VCS project entails some changes inside the ammonia oxidation reactor in order to prepare it for the placement of N₂O decomposition catalyst. The catalyst is delivered in the form of small star shaped extrudates which are filled into baskets beneath the primary catalyst gauze.

Secondary N₂O decomposition does not have any negative impacts with respect to

- Air: No additional emissions are caused by the application of the catalyst.
- Water: The application of the catalyst does neither consume nor release water.
- Waste: The application of the catalyst does not cause any waste generation. The catalyst will be supplied and taken back by BASF. The catalyst will be exchanged approximately every two years.
- Noise: The application of the catalyst does not lead to any additional noise generation.

The BREF confirms this view by stating that catalytic N₂O decomposition does not induce cross-media effects.¹³

6 Stakeholders comments:

Since the project activity is an invisible technical installation at the Caojing production site without any negative environmental or social impact, no local stakeholders can be identified. An international stakeholder consultation will be carried out in the context of the validation procedure by publishing the PD on the validator's website.

There are established channels of communication with external stakeholders like BASF emergency respond center, fire brigade, police, medical center, SCIP emergency respond center. Furthermore there is a hotline as well as a direct radio channel between the emergency respond centers of SBPC, SCIP and BASF. All these communication means are operating around the clock.

Contribution to Sustainable Development

The installation of the N₂O abatement catalyst is connected with the transfer of state-of-the-art technology to the Host Country. This includes the catalyst as well as the latest monitoring equipment. The latter will comply with the advanced European Standard EN14181. Therefore employees will build capacity in these quality management techniques that are not yet widely spread in China. Thus the gained knowledge of the local staff will also diffuse to the local community

¹³ European Commission: Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals, December 2006, page 123.

and enhance the overall ecological awareness in the Shanghai region. The commissioning and operation of monitoring equipment and catalyst will contribute to the creation of technical and organizational capacity of domestic contractors and their respective staff as well.

7 Schedule:

The following schedule shall apply:

Baseline measurements shall start in March 2009.

The project activity begins with the installation of the N₂O catalyst in the oxidation reactor. This shall take place after the finalization of the baseline measurement, which is expected for the beginning of October 2009. As starting date of the project/begin of the crediting period, the 1st October 2009 is indicated.

Validation of the project shall take place as soon as possible. An initial verification of emission reductions is planned in the 2nd half of 2009. An annual or semi-annual monitoring and reporting is envisaged.

8 Ownership:

8.1 Proof of Title:

The plant is a joint venture by BASF, Shanghai HuaYi (Group) Co. Ltd. and SINOPEC Shanghai Gao Qiao Petrochemical Corporation (SBPC).

Shanghai BASF Polyurethane Co., Ltd. (SBPC)
No. 25 Chu Jua Road
Caojing, Shanghai
Zip code 201508
People's Republic of China

Respective documentation regarding the ownership is available at validation.

8.2 Projects that reduce GHG emissions from activities that participate in an emissions trading program (if applicable):

Not applicable: The project activity is neither included in an emissions trading Program nor does it take place in a jurisdiction or sector in which binding limits are established on GHG emissions.

Annex 1

Second version replaces PD Version 1 from 4 June 2009. with the following adjustments/amendments:

Nr	Reference to request from validation report	Reference to section in PD	Comment
1	CL 3.1.2-1	PD 1.3	Project starting date included.
2	CL 3.1.7-1	PD 1.9	Date on the catalyst reduction efficiency has been amended.
3	CL 3.1.7-2	PD 7	The intended monitoring frequency has been made clear.
4	CL 3.1.7-3	Front page	Version number and version change protocol added.
5	CAR 3.1.7-1	PD 1.17	List of confidential documents added.
6	CAR 3.2.3-1	PD 1.12	Justification of plant operation starting date (after Dec. 2005) has been further elaborated.
7	CAR 3.2.4-1	PD 3.3	Values of normal operating parameters amended.
8	CAR 3.2.4-2	PD 3.3	Determination of normal operating values now conducted along option a of AM0034.
9	CAR 3.2.4-3	PD 2.4	Baseline determination steps have been modified.
10	CAR 3.2.4-4	PD 3.3, 4.2	CL _{normal} : The value has been indicated and way of its determination further explained.
11	CAR 3.2.5-1	PD 1.12	The management board decision on VCS project realization and the pre-consideration of crediting is included in the timeline description.
12	CAR 3.3.2-1	PD 4.3	Eventuality and conditions of downtime of the AMS is now considered in the PD.
13	CAR 3.3.2-2	PD 3.2	Table on performance characteristics and performance control of AMS has been amended.
14	CL 3.3.2-1	PD 3.3, 3.4	Application of EN14181 stipulations has been described in detail.
15	CL 3.4.2-1	PD 3.4	Determination of ex-ante emission factor has been further described and justified.
16	CL 3.6-1	PD 6	Existing channels of communication with external stakeholders have been further described.

Third version replaces PD Version 2 from 4 September 2009 with the following adjustments/amendments:

Nr	Reference to section in PD	Comment
17	PD 1.3/PD 1.4/ PD 4.4	Correction of inconsistency/typo: indication of emission reductions for year 2019.
18	PD 3.3/ PD 4.4	Inclusion of GWP _{N2O} in list of monitoring parameters.
19	PD 1.4/ PD 1.16	Correction of inconsistency/typo: indication of abatement factor
20	PD 3.2/ PD 3.3	Adjustment of indicated QA/QC procedures.