Projet Design Document (PDD)

This document must be completed without changing the format

SECTION A. General description of the project activity

A.1. Title of the project activity

YARA Pardies N_2O abatement project
Date: 24th May 2010
Version: 03

A.2. Description of the project activity (maximum one page)

The sole purpose of the proposed project activity is to reduce levels of N_2O emissions from the production of nitric acid at YARA's nitric acid plant at Pardies in South Western France.

Commercial nitric acid production started in November 1960. It is a 3.6 bar medium pressure plant with a daily design production output of 430 metric tonnes of HNO_3 (100% conc.) per day[1]. The plant's design campaign length is 300 days. Depending on whether or not the plant is shut down for maintenance purposes or exchange of the primary catalyst gauzes, the plant can be operated for around 340 days per year resulting in an annual production output of around 146,200 $tHNO_3$.

To produce nitric acid, ammonia (NH_3) is reacted with air over precious metal – normally a platinum-rhodium-palladium (Pt-Rh-Pd) alloy – catalyst gauze pack in the Ammonia Oxidation Reactor (AOR) of the nitric acid plant. The main product of this reaction is NO, which is metastable at the conditions present in the ammonia oxidation reactor:

$$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$$

Simultaneously, undesired side reactions yield nitrous oxide (N_2O), nitrogen and water:

$$4\ NH_3 + 4\ O_2 \rightarrow 6\ H_2O + 2\ N_2O$$

$$4\ NH_3 + 3\ O_2 \rightarrow 6\ H_2O + 2\ N$$

The NO from the primary reaction is then further oxidised to form NO_2:

$$2\ NO + O_2 \rightarrow 2\ NO_2$$

The NO_2 is later absorbed in water to produce HNO_3 – nitric acid:

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[1] As specified in section 1.2, Article 1, Annexe 2 of the plant-specific Arrêté Préféctoral No99/IC009 dated 25th Jan 1999. (All nitric acid quantities in this PDD are provided in metric tonnes of 100% concentrated HNO_3, unless otherwise indicated).

$$2\ NO_2 + H_2O \rightarrow HNO_3 + HNO_2$$
$$3HNO_2 \rightarrow HNO_3 + NO + H_2O$$

N_2O is a potent greenhouse gas with a Global Warming Potential (GWP) of 310[2]. Without any N_2O abatement technology, the plant would emit an average of 5.7 kgN_2O / $tHNO_3$, which means that the operation of the plant without any N_2O abatement technology installed would entail the emission of around 258,335 tCO_2e annually[3].

The project activity involves the installation of two full batches of N_2O abatement technology: a pelleted catalyst that will be installed inside the two AORs, underneath the precious metal gauzes. It is expected that this catalyst will reduce about 95% of current N_2O emissions on average over its lifetime. The first version of the PDD made an extremely conservative preliminary estimation of the abatement efficiency, based on the minimum guaranteed abatement performance of the catalyst supplier. However, since a QAL-2 tested Automated Monitoring System (AMS) has been installed, the plant has been recording accurate measurements of its project N2O emissions. The QAL-2 uncertainty percentage has been added to the average ppm concentration for the sake of achieving a more conservative figure. The resulting average N2O concentration of the two lines (recorded as hourly average values over a period of two months) is around 33ppm, which confirms that the abatement efficiency is currently higher than 95%. This data has been checked by the responsible AIE.

The N_2O abatement catalyst applied to the proposed project has been developed by YARA. Industrial trial runs for research and development of this catalyst have been taking place at YARA Pardies over the last few years. By now, the technology has been proven as an effective method of reducing N_2O emissions and is now installed in many plants around the world in Clean Development Mechanism (CDM) and Joint Implementation (JI) projects. The research and development phase is therefore considered complete and the catalyst would either a) simply be removed, in the case where there are no further incentives to continue its operation or b) just enough catalyst would be installed in order to comply with any national or local regulatory N_2O limits. The project specific options will be discussed in sections A.4.2, B.4 and B.5.

For monitoring the N_2O emission levels, YARA Pardies will install and operate two Automated Monitoring Systems in accordance with EU standards[4].

YARA Pardies adheres to ISO9001 management standards[5] and will implement procedures for monitoring, regular calibrations and QA/QC in line with the requirements of these standards.

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[2] IPCC Second Assessment Report (1995); applicable according to UNFCCC-decision 2/CP.3, paragraph 3.

[3] N_2O concentration in the stack before the installation of secondary catalyst has been measured since 1st January 2002 showing an average concentration equal to approximately 5.7$kgN_2O/tHNO_3$. This statement is based on an annual production output of 146,200 tHNO3 (430t/day for 340 days / year).

[4] See sections B.7.2 and Annex 3 for detailed information.

[5] All quality management documents are stored on the internal Pardies database and will be made available to the AIEs upon request.

A.3. Project participants

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
France (host)	YARA France SAS	No
Norway	YARA International ASA, Oslo (Norway)	No
Germany	N.serve Environmental Services GmbH (Germany)	No

This JI Project (Projet Domestique) will be developed as a party verified activity in accordance with UNFCCC decision 9/CMP.1, paragraph 23 by the host country France.

A.4. Technical description of the project activity

A.4.1. Location of project activity

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A.4.1.1. Host party (ies)

France

A.4.1.2. Region

Region: South West, Department: Pyrénées-Atlantiques

A.4.1.3. Commune

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Pardies

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

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The picture below illustrates the location of the plant.

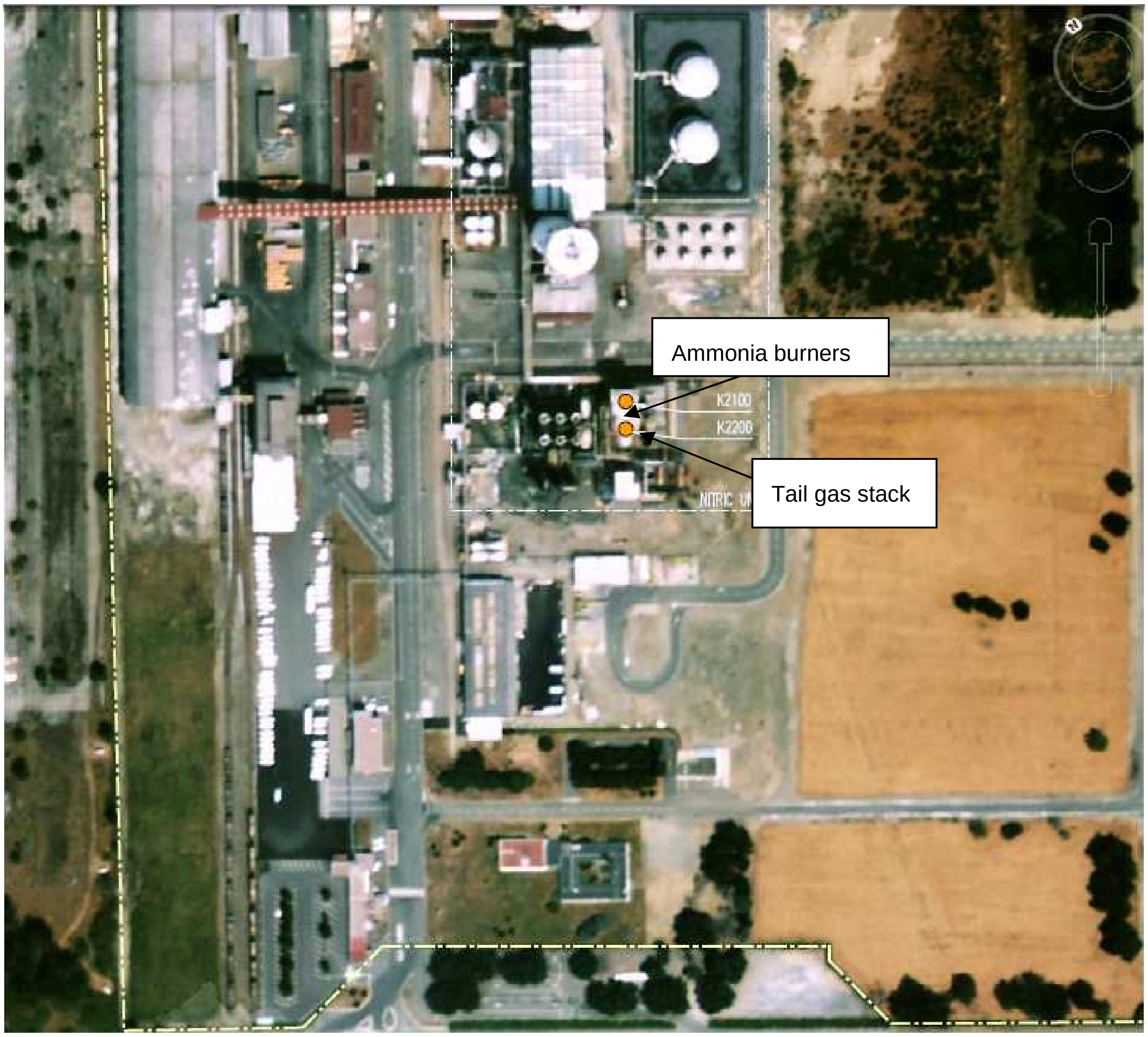

Figure 1: Location of YARA Pardies

Coordinates:

Ammonia burners:	43°22’21.32”N & 0°35’10.20”N
Tail gas stacks:	43°22’20.90”N & 0°35’10.08”W

A.4.2. Technology (ies) to be employed, mesures, operations or actions to be undertaken within the framework of the project activity

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The main parts of the plant as currently set up are the two ammonia burners inside which the ammonia oxidation reaction takes place, the 11 absorption towers, where the gas mix from the burner is led through water in order to form nitric acid, and the two tail gas stacks through which the off-gasses are vented into the atmosphere. The production lines join after the two burners and lead into 3 absorption towers, which form the nitric acid production process at 63% concentration. Thereafter, the majority of the gas is lead through the 53% concentration process with its 6 absorption columns and the remainder is fed to the 100% Concentrated Nitric Acid (CNA) process, which has 2 further absorption columns. The 53% and CNA lines re-join afterwards and split again at a point before the final tail gas treatment, leading into two

SCR de-NOx reactors and two tail gas expander turbines. The final off-gasses are then emitted through two stacks.

The precious metal gauze pack – i.e. the primary catalyst required for the formation of NO – has been manufactured by K.A Rasmussen AS located in Norway for a number of years. There is no plan to change the present gauze specifications for the duration of the project activity.

The project activity entails the installation of:

- N_2O abatement technology, which was installed in Pardies on an industrial trial level between 2002 and 2008. In January 2009 the two burners were half filled with new catalyst (760kg in each, making a total of 1,520kg) in order to be able to comply with the upcoming Arrêté Préfectoral that is likely to be applied in 2010 (see section B.4, 'Assessment of the present situation, the Status Quo' for more details on the application of the future Arrêté Préfectoral). At the shutdown in mid August 2009, the baskets underneath the primary catalyst in the ammonia oxidation reactors were filled to their maximum capacity with a total extra 1,600kg of catalyst (800kg per burner, which was sent from the Ambès plant) in order to undertake the project activity and achieve the maximum emissions reductions possible. ; and
- Specialised monitoring equipment installed at the tail gas stacks (detailed information on the AMS is contained in section B.7.2 and Annex 3).

Catalyst Technology

A number of N_2O abatement technologies have become commercially available in the past 3 years after several years of research, development and industrial testing. Since end of 2005, several CDM project activities employing various kinds of N_2O abatement catalysts have been registered with the CDM Executive Board. But these activities are limited to plants located in developing nations.

The only national regulation limiting N_2O emissions in France is a compulsory limit applying to nitric acid production on French territory of $7kgN_2O/tHNO_3$ for all plants commissioned after February 1998[6]. However, due to lack of incentives for voluntary reductions before 2008[7] and the general absence of more ambitious legal limits on industrial N_2O emissions in nearly all the European Union member states, the vast majority of EU-based plant operators have so far not invested in N_2O abatement devices.

For the purpose of developing and testing its own catalyst system YARA58 Y 1 ®, YARA International ASA has been conducting industrial trial runs of the catalyst in several plants in France since 2005.

The plant operated by YARA Pardies has been part of the catalyst industrial trial programme. However, these trial runs are now considered complete and are no longer necessary.

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[6] See Section II « Pollution de l'air », article 30, sub-section 6 of the « Arrêté Ministériel du 02/02/98 relatif aux prélèvements et à la consommation d'eau ainsi qu'aux émissions de toute nature des installations classées pour la protection de l'environnement » http://www.ineris.fr/aida/?q=consult_doc/consultation/2.250.190.28.8.2269

[7] See decision 9/CMP.1, paragraph 5: "ERUs shall only be awarded for a Crediting Period after the beginning of 2008."

In addition, due to potential operational problems associated with installing abatement catalyst, the YARA management decided not to fill the catalyst containment system to its maximum capacity during the research and testing phase and as such, the abatement efficiency of the catalyst was not optimised. The greater the bed depth of catalyst installed inside the burner, the more likely it will be that the plant encounters problems associated with pressure drop. This may affect the gas flow through the burner, potentially lowering nitric acid production yields. Additionally, the heavier the load of catalyst, the stronger must be its supporting containment structure and the more technical modifications will be needed to accommodate the increased load.

However, participation in the Projet Domestique offers a real incentive to continue operating the secondary catalyst after the industrial trials have come to an end and to achieve the maximum emissions reductions possible from this catalyst. Since a project-specific methodology for N2O reduction at nitric acid plants was finally approved by the government in July 2009, the baskets were therefore filled to their maximum capacity at the following plant shut-down in mid-August. The plant started operation with the full batches of catalyst on the 20th August 2009.

Figure 2: Installation of secondary catalyst

YARA Pardies has installed the YARA 58 Y 1® catalyst system consisting of an additional base metal catalyst that is positioned below the standard precious metal gauze packs in the ammonia burners. Operation with the full batch of catalyst installed began in mid-August 2009.

A secondary catalyst reduces N_2O levels in the gas mix resulting from the primary ammonia oxidation reaction. A wide range of metals (e.g. Cu, Fe, Mn, Co and Ni) have shown to be of varied efficiency in N_2O abatement catalysts. The YARA 58 Y 1® abatement catalyst is made of cylindrical pellets containing cobalt as an active ingredient. The abatement efficiency has been shown to be even greater than 95% in the following reaction:

$$2\ N_2O \rightarrow 2N_2 + O_2$$

If operated properly, the secondary catalyst system may significantly reduce N_2O emissions for up to three years before the catalyst material needs to be replaced.

The YARA 58 Y 1® abatement catalyst has been proven by industrial testing not to affect plant production levels[8]. Also, it does not contaminate the nitric acid produced in any way, neither with cobalt nor with any of the other catalyst materials[9]. No additional heat or other energy input is required, because the temperature levels present inside the ammonia oxidation reactor suffice to ensure the catalyst's optimum abatement efficiency. There are no additional greenhouse gases or other emissions generated by the reactions at the N_2O abatement catalyst.

Basket modifications and Heat Shield design

Most nitric acid plants have some sort of basket structure that gives structural support to the precious metal gauzes. The ammonia oxidation reactors in the YARA Pardies nitric acid plant normally operate at temperatures around 870°C, which causes the basket assemblies to expand compared to when the plant is not operational (i.e. during installation of the catalyst).

This effect increases the basket diameter by 1.The ammonia oxidation reactors of the Pardies plant have a diameter of 3300 mm that therefore would expand by around 30 mm when in operation. To counter this occurrence, the baskets that support the catalyst installations and the gauze packs have had to be modified[10] to provide containment of the pelleted beds in a manner that prevents preferential gas flow at the circumference and to optimise the N_2O abatement efficiency of the catalyst.

N_2O abatement catalyst installation

The secondary catalyst itself can be installed during a routine plant shut-down and gauze change. The pellets are poured into the support basket arrangements and levelled. The gauze packs are then installed above the levelled catalyst pellets.

After the end of its useful life, the catalyst will be refined, recycled or disposed of according to EU regulations, hence fulfilling sustainability standards. See section D.1 for more information.

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[8] See the European IPPC Bureau publication „Integrated Pollution Prevention and Control; Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilizers (August 2007), page 124 therein. This source states that NO yields for the ammonia oxidation reaction remain largely unchanged when operating secondary N_2O abatement catalysts.

[9] This has been proven in industrial testing. The underlying information is commercially sensitive and will be made available to the AIE mandated with the determination procedure upon request. General information on this question is contained in the European IPPC Bureau publication „Integrated Pollution Prevention and Control; Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilizers (August 2007), page 124 therein (available for downloading under http://eippcb.jrc.ec.europa.eu/pages/FActivities.htm)

[10] The modifications required to prevent preferential gas flow are of commercially sensitive nature. The AIE representative will be allowed to verify this information during the on-site visit.

YARA Pardies nitric acid plant operates at a pressure of around 3.6 bars inside the ammonia oxidation reactors. Through the introduction of the full batches of secondary catalyst into the ammonia reactors, a slight additional pressure drop (ΔP) is expected to occur. This ΔP may lead to a slight reduction in ammonia conversion efficiency and hence a very small reduction in nitric acid output. In practice however, this loss of production is unlikely to be significant.

Technology operation and safety issues

As mentioned before, the secondary abatement technology has been tested in several industrial trials and has proven to be a reliable and environmentally safe method of reducing N_2O.

Once installed, the catalyst and the Automated Monitoring Systems (AMS) will be operated, maintained and supervised by the employees of YARA Pardies according to European industry standards[11]. Due to the long-term catalyst development phase, there is expert know-how readily available within the YARA group. Therefore, YARA Pardies is very confident that the effective operation of the catalyst technology, the operation of the monitoring systems and the data collection, storage and processing can be managed in accordance with the Projet Domestique requirements. Adherence to the applicable standards will be ensured by thorough and regularly repeated training sessions for the YARA employees involved.

A.4.3. Estimated quantity of emissions reductions during the crediting period

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Table 1. Estimation of the emissions reductions to be issued to the project activity (calculated in section B), relative to the Benchmark emissions factor.

Year	**Estimation of annual emissions reductions in tonnes of CO_2e**
2010 (Aug - Dec)	37,646
2011	90,349
2012	63,836
Estimation of total emissions reductions over the crediting period (tonnes of CO_2e)	**191,831**
Annual average emissions reductions	63,944

* Due to the likely inclusion of N_2O emissions emanating from nitric acid production into the EU ETS from 1st January 2013 onwards, the project may not be eligible to earn ERUs after that time or continuing the project under the JI may not be economically viable.

The French Designated Focal Point (Le Ministère de l'Écologie, de l'Énergie, du Développement Durable et de la Mer (MEEDDM)) has ruled that a universal 'benchmark emissions factor' (EF_{BM}) should be applied for all nitric acid plants eligible to undertake Projets Domestiques, regardless of their size, their technical characteristics and their past

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[11] See section B.7.2 below.

and present emissions levels. A benchmark value of 2.5 $kgN_2O/tHNO_3$ for the period until 31st December 2011 will be applied, followed by a value of 1.85 $kgN_2O/tHNO_3$ for the period until 31st December 2012. This benchmark value has been taken into account in the summary table above, but the detail and its implications on the project's operation will be dealt with in section B. below.

A.5. Approval of the project by the relevant parties

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The project-specific methodology "Methodology for Projet Domestiques: Catalytic reduction of N_2O at nitric acid plants" was approved by the MEEDDM in July. As long as a project intends to fully comply with the requirements of this methodology, the MEEDDM does not issue a Letter of Endorsement (LoE). A final decision regarding approval of the Projet Domestique will be taken at the end of the official project approval procedures that will be initiated upon the submission of the full project dossier. If the decision is a positive one, the MEEDDM will issue a confirmation in the form of an official Letter of Approval (LoA).

The reference case benchmark emissions factors were specified following an official meeting between representatives of the French nitric acid industry and the French government on the 10th April 2009 and are to be applied as follows:

2009	**2010**	**2011**	**2012**
2.5kg	2.5kg	2.5kg	1.85kg

Table 2: Applicable projet domestique benchmark emission factors (kg $N_2O/tHNO_3$)

If any of the above values are subsequently revised during the course of the project activity, the project proponents explicitly reserve the right to apply such new benchmark values for the respective project periods.

SECTION B. Reference case scenario and monitoring methodology

B.1. Title of the reference case and monitoring methodology to be applied to the project activity

« Methodology for Projet Domestiques : Catalytic reduction of N_2O at nitric acid plants »

B.2. Justification of the choice of methodology and reasons for which it is applicable to the project activity

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Regulatory framework

The regulatory framework for implementing JI projects in France is influenced by several acts of law. The fundamental framework is provided by the Kyoto Protocol to the United Nations' Framework Convention on Climate Change ("UNFCCC") and subsequent decisions by UNFCCC-entities, most importantly the decisions of the Conference of the UNFCCC Parties serving as the Meeting of Parties to the Kyoto Protocol (“CMP”) and the Joint Implementation Supervisory Committee (“JI SC”).

In addition, there is the European Union legislation adapting the Kyoto JI framework for application in its member states such as the Emissions Trading Directive[12], the Linking Directive[13] and various JI relevant decisions by EU bodies[14]. Besides acts of law of direct relevance, there are also Directives that have an indirect influence on JI implementation such as the IPPC Directive[15].

EU Directives do not entail direct consequences on private entities located in the EU member states. In order to be enforceable on member state level, they generally have to be transformed into national legislation by the respective member state. These national transformation acts, as well as other national legislation, are the third layer of the regulatory framework relevant for JI project implementation. In France, the most relevant pieces of legislation are the ‘Décret n° 2006-622 du 29 mai 2 006’[16] for the application of articles L. 229-20 to L. 229-24 of the ‘code de l'environnement’, and the ‘Arrêté du 2 mars 2007’[17] of the ‘Ministère de l'écologie et du développement durable’.

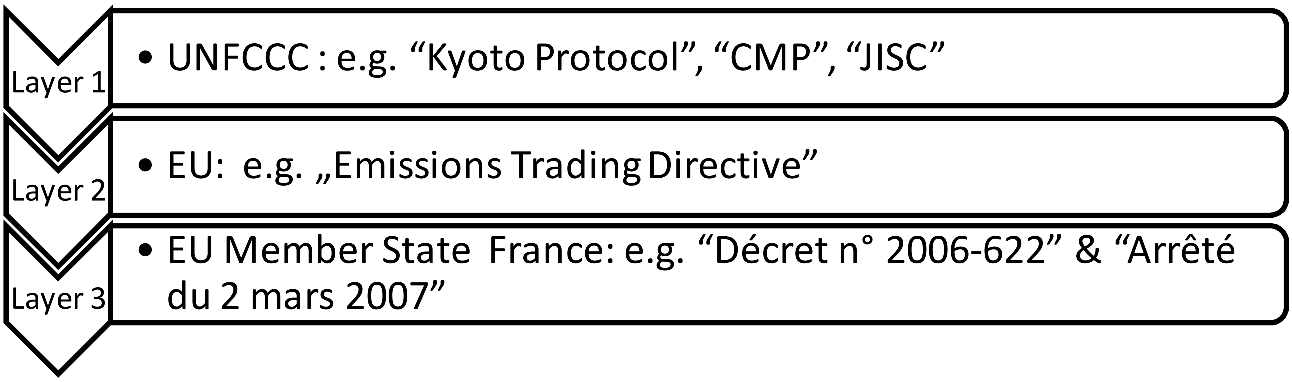

Illustration: Three layers of jurisdiction relevant for the implementation and subsequent operation of N_2O nitric acid JI projects in France

Applicability of Methodology « Catalytic reduction of N_2O at nitric acid plants»

The methodology for the reduction of N_2O emissions at nitric acid plants in France (“Catalytic reduction of N_2O at nitric acid plants”) was finally approved by the MEEDDM in July and is applicable to project activities aiming to install either secondary or tertiary N_2O abatement technology. The Pardies plant consists of two ammonia burners feeding into a total of 11

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[12] 2003/87/EC, published on the internet under http://ec.europa.eu/environment/climat/emission/implementation_en.htm

[13] 2004/101/EC, published on the internet under http://ec.europa.eu/environment/climat/emission/implementation_en.htm

[14] Such as the Double Counting decision 2006/780/EC, published on the internet under http://ec.europa.eu/environment/climat/emission/pdf/l_31620061116en00120017.pdf

[15] 2008/1/EC, published on the internet under http://ec.europa.eu/environment/air/pollutants/stationary/ippc/index.htm

[16] Published on the internet under http://www.legifrance.gouv.fr/affichTexteArticle.do;jsessionid=85B1492FA603258E5FA3B94465CA21C1.tpdjo07v_2?cidTexte=JORFTEXT000000268218&idArticle=LEGIARTI000006251745&dateTexte=20060530&categorieLien=cid

[17] Published on the internet under http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000000430873&dateTexte=

absorption towers, the off-gasses of which are emitted through two stacks. The support baskets in the two ammonia reactors were filled to their maximum capacity with full batches of the secondary N_2O catalyst system during a plant shut-down in mid-August 2009; the abatement systems are installed underneath the primary catalyst gauzes. This corresponds to the defined scope of the methodology.

Also, the project activity does not lead to the shut-down of any N_2O abatement devices already installed.

Moreover, the project activity will not increase NO_X emissions. The secondary catalyst technology installed has no effect on NO_X emission levels. This has been scrutinised in industrial testing over extended industrial process application[18]. In addition, the regular and compulsory NO_X tests conducted by YARA under the supervision of the responsible local environmental authority would reveal any changes in NO_X emission levels.

B.3. Description of GHG sources included in the project boundary

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The project boundary entails all parts of the nitric acid plant in so far as they are needed for the nitric acid production process itself. With regard to the process sequence, the project boundary begins at the inlets to the ammonia burners and ends at the two tail gas stacks. Any form of NO_X-abatement device shall also be regarded as being within the project boundary.

The flow charts below provide an overview on the plant's process design:

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[18] See the European IPPC Bureau publication „Integrated Pollution Prevention and Control; Reference Document on Best Available Techniques for the Manufacture of Large Volume Inorganic Chemicals – Ammonia, Acids and Fertilizers (August 2007), page 124 f. therein. This source states that NO yields for the ammonia oxidation reaction remain unchanged when operating secondary N_2O abatement catalysts.

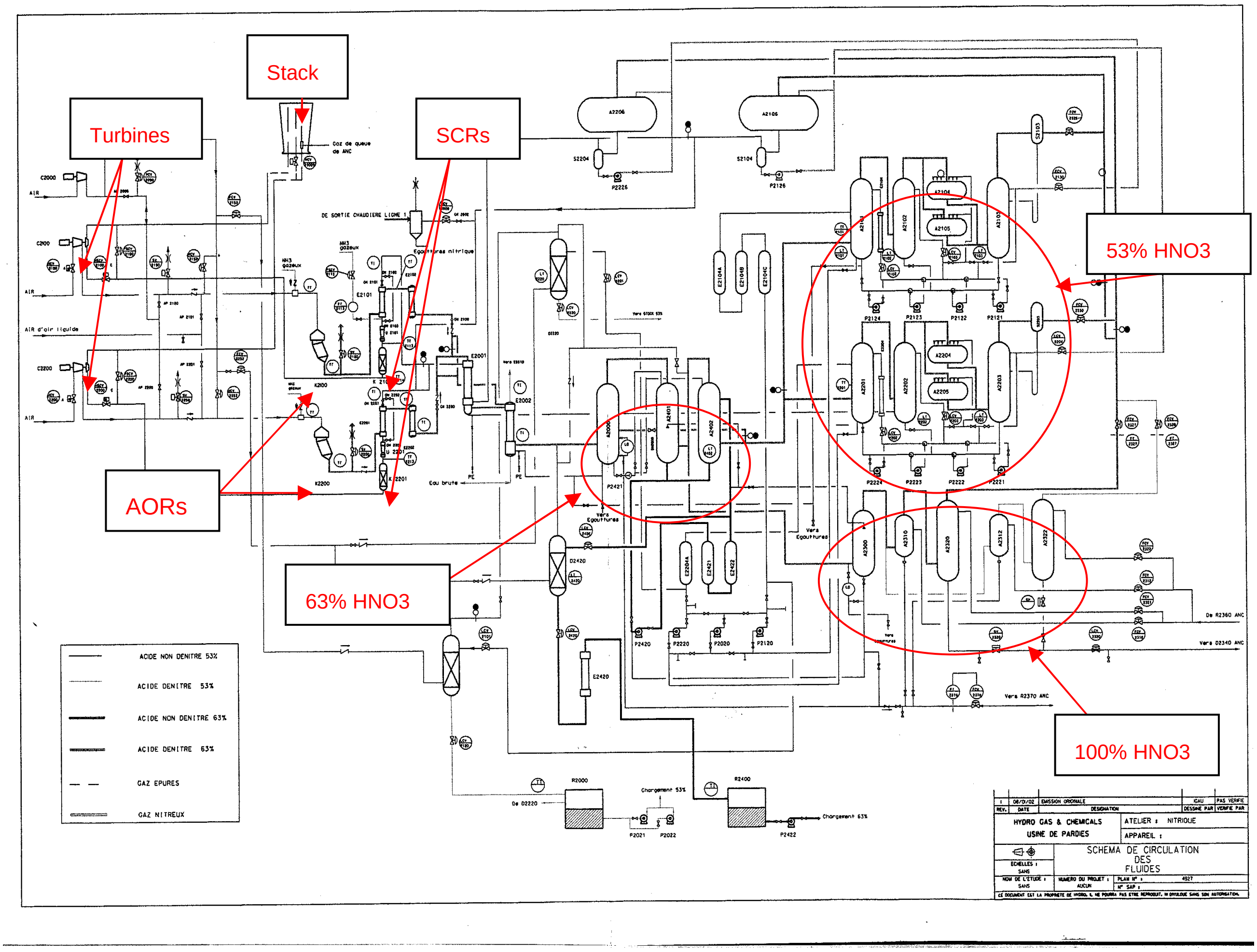

Illustration 1: Complete flow chart for the YARA Pardies nitric acid plant.

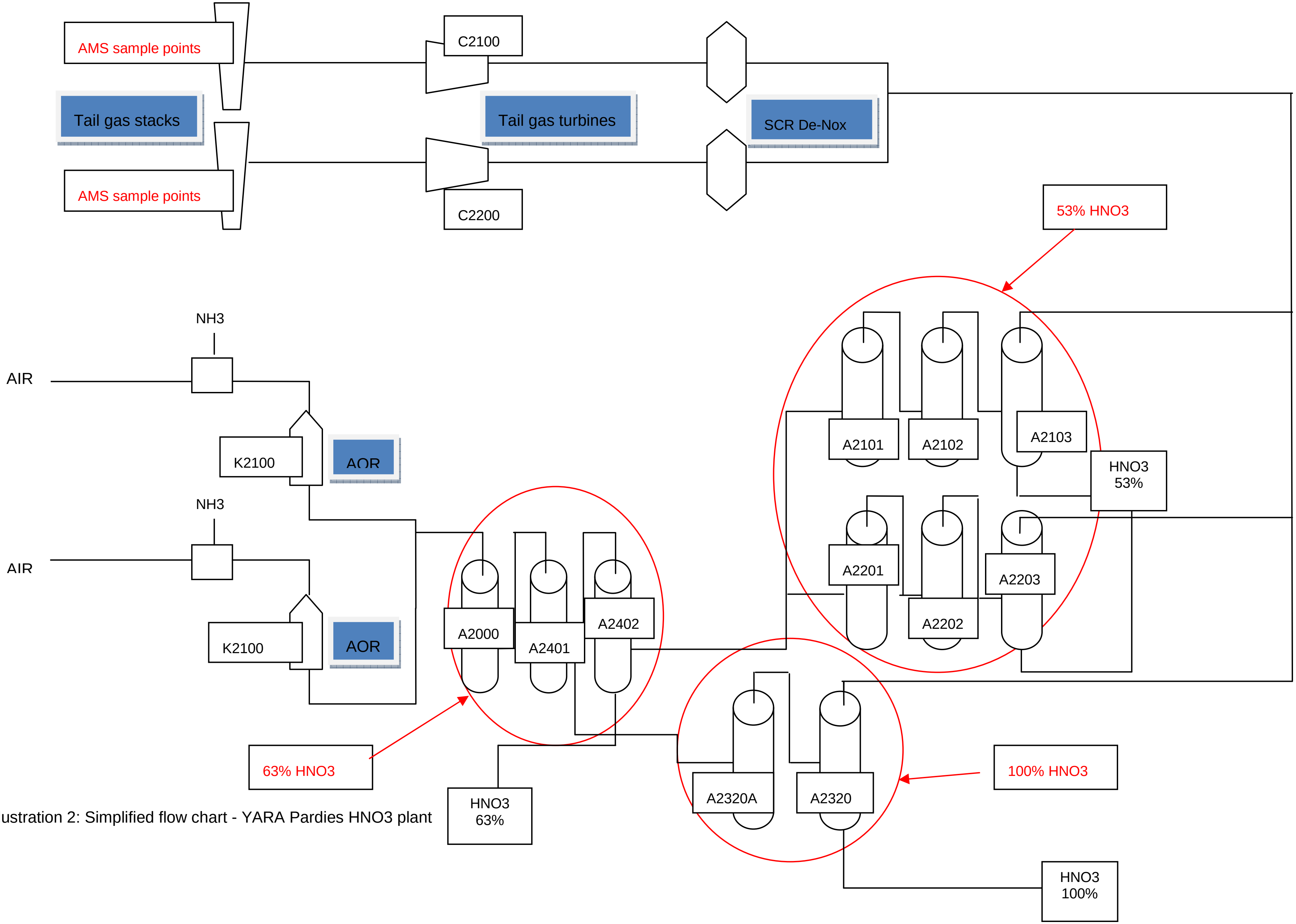

Illustration 2: Simplified flow chart - YARA Pardies HNO3 plant

The Selective Catalytic Reduction (SCR) units for the reduction of NOx emissions at YARA Pardies shall be regarded as being within the project boundary. This is because SCR technology does not reduce N_2O emission levels and thus the applicable benchmark value shall be unaffected.

	Source	**Gas**	**Included ? (yes/no)**	**Justification / explication**
Reference Case	Benchmark emissions factor	CO_2	No	The project does not lead to any emissions of CO2.
		CH_4	No	The project does not lead to any emissions of CH4.
		N_2O	Yes	
		others	N/A	
Project		CO_2	No	The project does not lead to any emissions of CO_2
		CH_4	No	The project does not lead to any emissions of CH_4
		N_2O	Yes	
		others	N/A	

Table 3. Sources and gases included in the project boundary

B.4. Identification and description of the reference case scenario (Business as usual scenario)

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The selection of the business as usual scenario involves the identification of all possible reference case scenarios and the elimination of those that are not viable.

This analysis is carried out in three steps :

Step 1. Identify the reference case scenarios that are technically feasible within the framework of the project activity:

The reference scenario alternatives should include all possible options that are technically feasible to handle N_2O emissions. The principally debatable options defined by the methodology are:

a) Continuation of the S*tatus Quo*. The continuation of the current situation, where:
   - i) there is no N_2O destruction technology installed
   - ii) an N_2O abatement catalyst has already been partially installed for industrial trials, but the catalyst would have been removed at the end of these trials
   - iii) only sufficient catalyst is installed to ensure compliance with any applicable legal N_2O regulations.

b) Alternative uses of N_2O, such as:
   - Recycling of N_2O for feedstock
   - External use of N_2O

c) Installation of a Non-Selective Catalytic Reduction unit (NSCR)

d) Implementation of a primary, secondary or tertiary N_2O destruction technology in the absence of a ‘Projet Domestique’

The analysis must include the implementation of the destruction technology in the absence of the registration of the project activity as a Projet Domestique.

Assessment of the present situation, the “Status Quo”

A certain amount of N_2O abatement catalyst has been installed in YARA Pardies for the past several years as part of an industrial research and development programme. However, since the catalyst is now already installed in many plants around the world in projects implemented under the CDM and JI and its performance has been adequately proven, this industrial testing is now considered complete and is no longer necessary.

Theoretically therefore, in the absence of any regulation limiting N_2O emissions at its plant, Yara Pardies could simply have removed the installed N_2O abatement catalyst at the end of the research and development phase at the end of the previous production campaign. However, in December 2008, the local DRIRE (Directions Régionales de l'Industrie de la Recherche et de l'Environnement) informed the plant that a plant-specific ‘arrêté préféctoral’ would be introduced in the very near future, which would limit N_2O emissions at the Pardies plant. At the time of project implementation, the exact value and start date of this future ‘arrêté préféctoral’ (AP) was yet to be confirmed. However, the DRIRE had communicated to Pardies via email that they would recommend a value of 2.5kg $N_2O/tHNO_{3,}$ as is applicable at the Yara Ambes plant. In view of the fact that a) an AP would almost certainly come into force in the very near future (even though the exact start date was unknown) and b) that plant shutdowns only occur very rarely at Pardies, since a standard production campaign is around 300 days, the reference case ‘business as usual’ scenario would therefore be to install just enough catalyst material to achieve compliance with the likely future ‘arrêté préféctoral’ value of 2.5kg $N_2O/tHNO_3$, but no more.

On 4th May 2010, more than 8 months after the installation of the full batches of catalyst, a draft ‘arrêté préféctoral’ was presented to the Pardies plant for their comments. Article 2.1 of the draft paper proposes to apply a maximum N_2O value of 2.5kg/tHNO3 until 30 June 2012 and then a lower value of 1.85kgN_2O/ $tHNO_3$ from that point onwards. Since these suggested regulatory values are completely in line with the benchmark values set by the government for plants undertaking JI projects, the 'arrêté préféctoral' in its proposed current form would have no affect on the emissions reductions eligible to receive ERUs.

Alternative uses of N_2O

The use of N_2O as a feedstock for the production of nitric acid is not feasible, because it is not possible to produce nitric acid from N_2O at the quantities emitted during nitric acid production.

The use of N_2O for external purposes is not practised anywhere in the world, as it is technically and economically unfeasible. The quantity of gas to be used as a source is enormous compared to the amount of nitrous oxide that could be recovered. The average N_2O concentration in the tail gas of the Pardies plant during standard operation without any abatement catalyst would be around 913ppmv[19], which is considered far too low to economically recover and separate N_2O from the tail gas.

Therefore, the baseline scenarios under b) are excluded from further assessment.

Step 2. Eliminate the reference scenario alternatives that do not comply with national or local regulations :

Although there are currently no national or local regulations regarding N_2O that are applicable to the Pardies nitric acid plant, a draft 'arrêté préféctoral' was presented to the plant for their comments on 4th May 2010. Article 2.1 of the draft paper proposes to apply a maximum N_2O value of 2.5kg/tHNO3 until 30 June 2012 and then a lower value of 1.85kgN_2O/ $tHNO_3$ from that point onwards. Since these suggested regulatory values are completely in line with the benchmark values set by the government for plants undertaking JI projects, the 'arrêté préféctoral' in its proposed current form would have no affect on the emissions reductions eligible to receive ERUs.

The limits proposed by the draft 'arrêté préféctoral' do not represent the maximum N_2O reductions achievable. Using secondary catalyst technology, N_2O emissions could theoretically be lowered significantly below the stated values. However, to minimise the costs and potential impact on nitric acid production (as detailed above in step B.4), the reference case scenario would be for Yara to install only as much volume/weight of N_2O abatement catalyst as is necessary to ensure compliance with any applicable 'arrêté préféctoral'.

NO_X-emissions are currently regulated by an 'arrêté préféctoral' (N°99/IC/009) issued in February 1998, which specifies a permitted level of 4.5kg NOx/$tHNO_3$. The plant is comfortably in compliance with these requirements, since its average NOx emissions in the past year have been around 1.28kg NOx/$tHNO_3$[20].

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[19] This estimate value is derived from the average N_2O emissions readings taken at Pardies in the 3 months prior to catalyst installation.

[20] Average NOx emissions from January to December 2008, based on daily averages, were 205ppm (1.28kg/$tHNO_3$)

YARA Pardies' NO_X emissions have remained constant and in compliance with the regulatory limit also after the installation of the additional secondary catalyst. This is safeguarded by the fact that NO_X emissions are regularly reported to the responsible local environmental authority[21].

Accordingly, the NSCR scenario alternative could be triggered by NO_X regulation. From this perspective, YARA Pardies could be forced to reduce N_2O in a reference scenario if NO_X regulation forced the plant operators to install NSCR technology.

However, the installation of a NSCR de-NO_X catalyst unit is uneconomic, because YARA Pardies is already in compliance with the prevailing NO_X regulations, thanks to its two existing SCR units. Also, NSCR units require additional natural gas or ammonia to achieve sufficient tail gas temperatures and thereby the right reducing environment inside the catalyst, leading to comparably high operational costs. The gas mix led through the absorption towers has been cooled down to a temperature level below that required for NSCR abatement catalysts to function[22]. Because of this, an NSCR abatement system would only work if the stack gas mix is re-heated.

If even lower NO_X levels were to be introduced, the most economical option would be to upgrade the existing SCR NO_X abatement units already installed at the plant. However, YARA Pardies is currently achieving NO_X-emission levels significantly below the applicable limit so that such a scenario would be extremely unlikely.

As the SCR de-NO_X catalyst devices are already very efficient, there would be no point in also installing NSCR, even if this technology were to be considered an alternative option[23].

In consequence, all but two of the above scenarios, a) i and a) ii, are in compliance with all applicable laws and regulatory requirements. Therefore scenarios a) i and a) ii will be eliminated from further assessment since they would not comply with the local regulations on N_2O limits that are to be introduced in the immediate future.

Step 3. Eliminate the reference scenario alternatives that would face prohibitive barriers (barrier analysis):

On the basis of the remaining technically feasible alternatives that comply with local and national regulations, the project proponent must establish a complete list of the barriers that would prevent the implementation of the various alternatives in the absence of the Projet Domestique.

The identified barriers are:

a) Investment barriers;

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[21] DRIRE: Directions Régionales de l'Industrie de la Recherche et de l'Environnement

[22] NSCR abatement catalysts require a minimum gas mix temperature of at least 550℃ in order to operate effectively; see the booklet no. 2 of the European Fertilizer Manufacturers Association (EFMA), published in the internet under http://www.efma.org/EPUB/easnet.dll/ExecReq/Page?eas:template_im=000BC2&eas:dat_im=000EAE (page 17 therein) for further information.

[23] For other disadvantages of NSCR technology see an EFMA-booklet published in the internet under http://www.efma.org/EPUB/easnet.dll/ExecReq/Page?eas:template_im=000BC2&eas:dat_im=000EAE (page 18 therein).

b) Technological barriers, including :
  - Technical and operational risks of the alternative scenarios;
  - Technical efficiency of the alternatives (i.e. destruction of N_2O, abatement efficiency);
  - Lack of qualified personnel;
  - Lack of infrastructure for implementing the technology;

c) Common practice barriers, including :
  - Technology with which project developers are not familiar;
  - There is no other similar project in operation in the relevant geographical area ;

Investment barriers

The investment barrier analysis asks which of the remaining scenario alternatives is likely to be prevented by the costs associated with it becoming reality. The assumption is that these scenarios would be unlikely to be the Business as Usual scenario.

None of the N_2O destruction technology options (including NSCR) are expected to generate any significant financial or economic benefits other than JI related income. The N_2O destruction technology options do not create any marketable products or by-products. However, any operator willing to install and thereafter operate such technology generally faces significant investment and additional operating costs.

Therefore, plant operators would face significant investment requirements if they decided to install N_2O abatement (including NSCR) technology. See section B.4 step 2 for additional information on investment barriers facing NSCR technology. These barriers would only be considered as overcome if there were a legal obligation to reduce N_2O emissions.

As demonstrated under Step 2 above, there are no legal obligations that would require the elimination of any of the remaining scenarios.

Since catalyst material is expensive and potential operational problems may occur with increased catalyst loads, abating emissions to a level beyond that required for compliance with any legal N_2O limits is only made economically viable by means of Projet Domestique revenues. However, while any reference scenario alternatives that include the implementation of N_2O abatement catalysts would entail considerable investment barriers, the application of a mandatory ‘arrêté préféctoral’ by the local DRIRE in the immediate future means that the “**Status quo**” should not be interpreted to face such barriers. This is because the requirement to invest in some form of N_2O abatement technology from the date of application of the ‘arrêté préféctoral’ (which is now expected sometime in 2010) is not connected to the proposed JI project activity.

For the purpose of this PDD, the “Status Quo” scenario is considered not to face any significant investment barriers.

Technological barriers

Neither of the two possible technological barriers listed above, ‘lack of qualified personnel’ and ‘lack of infrastructure for implementing the technology’ are applicable for this particular project. Firstly, Yara personnel do have experience of working with this catalyst due to the industrial trials that have taken place at Pardies, and secondly, sufficient infrastructure does exist to enable its implementation.

However, all of the available N_2O abatement technologies have to be integrated in the nitric acid plant. Primary and secondary abatement technologies are installed inside the ammonia oxidation reactor where they may, if not correctly designed and installed, interfere with the nitric acid production process by causing a deterioration of product quality or a loss of production output. Tertiary measures require the installation of a complete reactor between the absorption column and the stack, as well as a re-heating system, which may cause significant downtime of the plant during construction and commissioning[24].

These technical barriers can be demonstrated by the fact that the YARA management decided not to fill the catalyst containment system to its maximum capacity during the research and testing phase. The greater the bed depth of catalyst installed inside the burner, the more likely it will be that the plant encounters problems associated with pressure drop. This may affect the gas flow through the burner, potentially lowering nitric acid production yields. Additionally, the heavier the load of catalyst, the stronger must be its supporting containment structure and the more technical modifications will be needed to accommodate the increased load.

It is therefore unlikely that any plant operator would install such technologies on a voluntary basis without the incentive of any regulatory requirements (emissions caps) or financial benefits (such as revenues from the sale of ERUs).

However, due to the application of a mandatory ‘arrêté préféctoral’ by the local DRIRE at some point in 2010, the option of *not* installing some form of N_2O abatement device cannot be considered if production is to be continued at Pardies. Consequently, the scenario alternative “Status quo” should be regarded as not facing any significant technological barriers.

Common practice barriers

This test reconfirms the previous assessments: If the steps taken so far have led to the conclusion that one or more reference scenario alternatives meet investment related or technological barriers, these scenarios should be excluded. Of course, similar plants that gain ERU revenues by participating in the JI and thus can overcome the identified barriers by the additional financial means available are not to be taken into account.

So far, secondary catalyst technology has only been operated in some European countries on an industrial trial basis. Researching this technology made sense due to the prospective revenues obtainable under the Kyoto Protocol’s Clean Development Mechanism (CDM) by employing it in nitric acid plants located in developing nations on a voluntary basis. Also, it is expected that N_2O emissions from nitric acid production may be included in the European

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[24] Also see footnotes 22 and 23 for further information and reference on NSCR technology.

Union Emissions Trading Scheme ("EU ETS")[25] or regulated otherwise. Both aspects theoretically could provide some incentive for developing N_2O abatement technology.

However, now that research and development has been completed and secondary catalyst technology is being employed successfully in many CDM and JI projects worldwide (which excludes the suggested barrier "technology with which project developers are not familiar"), plant operators would no longer be willing to incur the costs associated with the continued operation of such technology. In the case where plants are subject to N_2O regulations and the installation of some catalyst is therefore unavoidable, these plant operators would only be willing to incur costs associated with the operation of such technology in order to comply with these regulations – they would not be willing to incur the additional costs required to increase catalyst quantities and achieve the maximum abatement efficiency. Even for the very few French nitric acid producers for whom mandatory local N_2O limits are applicable (currently only three), the only incentive remaining to achieve emissions reductions beyond those required by law is to take advantage of the incentives available under the Kyoto Protocol's Joint Implementation ("JI") mechanism. While this option has in principle been available since the beginning of 2008, EU member states took some time to develop a coherent policy approach on whether or not to allow JI participation in their respective territories, and if so, under which conditions.

The second argument raised above regarding the inclusion of nitric acid N_2O emissions in the EU ETS is not likely to become relevant for France until January 2013. On 23rd January 2008 the EU Commission issued a proposal[26] upon reviewing the EU ETS that suggests that nitric acid N_2O should be covered in the scheme's third trading period, commencing -in 2013. While some EU member states have chosen to 'opt-in' their nitric acid sector into the EU ETS,[27] thereby including the plants located on their territory already during the second trading period (2008 to 2012), such a decision is extremely unlikely for France after the government has decided to allow JI participation.

Recently, France has decided to principally allow JI participation (Projet Domestique) with regard to projects aiming to reduce N_2O emissions from nitric acid production. In reaction to this decision, nitric acid producers in France are beginning to look at employing N_2O abatement technology in order to participate in the JI.

Such JI projects are currently being developed across the EU in Poland, Lithuania, Hungary, Bulgaria, France, Finland, Sweden and Germany.

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[25] On 23rd January 2008, the EU Commission published a communication on its post-2013 climate change strategy (see http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2005:0035:FIN:EN:PDF), which announces the determination to expand the EU ETS beyond its present scope, especially mentioning the inclusion of non-CO_2 gasses into the system. This development is no news to the industry, because responding to Article 30 of the EU ETS Directive 2003/87/EC, the Commission had submitted a report to the European Parliament and the Council considering the inclusion of non-CO_2 GHGs into the EU ETS already in November 2006.
See the EU homepage under http://ec.europa.eu/environment/climat/emission/pdf/com2006_676final_en.pdf for this report which expressly considers extending the EU ETS into N_2O emissions (see page 6 therein).

[26] See footnote 25

[27] Norway, the Netherlands, Austria and Italy

Conclusion

The only reference scenario alternative that is not prevented by any one of the barriers and that is in full compliance with the prevailing laws and regulations in France is reference scenario 1a: the continuation of the current situation “Status Quo”, where just enough N_2O reduction catalyst would be installed in order to ensure compliance with the plant-specific N_2O regulatory limits that are likely to be introduced in the immediate future. The most likely scenario (according to a draft regulation proposed in May 2010) is that a level of 2.5kg $N_2O/tHNO_3$ will shortly be applied at Pardies, falling to 1.85kg $N_2O/tHNO_3$ from 30th June 2012. Therefore, this is identified as the applicable reference scenario for the proposed project activity.

All other alternatives are eliminated.

In case of a change in environmental legislation (i.e. the introduction of more stringent NO_X- or N_2O-regulations) that could lead to a change in the results of this assessment, the above procedures shall be repeated. The legal requirements regarding NOx and N_2O emissions levels will therefore be continuously monitored throughout the crediting period.

B.5. Description of how the emissions reductions achieved as a result of the project activity are greater than those that would be achieved in the absence of the Projet Domestique (evaluation and demonstration of additionality)

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In order to demonstrate that the project is additional to business as usual, (i.e that the results of the project in terms of N_2O emissions are different to those of the baseline scenario), the project proponent must show a step-by-step assessment, in accordance with Annex 3 of the “Arrêté du 2 Mars 2007” and described in the methodology “Catalytic reduction of N_2O at nitric acid plants”

Identification of realistic alternative scenarios

The first step consists of identifying the realistic alternatives to the proposed project. The project proponent must summarise the different options that remain available to him after completion of the baseline scenario selection analysis in Section B.4 above:

- Implementation of the project activity

  The installation of two batches of secondary N_2O abatement catalyst. The containment systems are filled to maximum capacity to try and achieve the greatest possible reduction of N_2O emissions.

- The implementation of alternative investments that result in a comparable production of goods or a comparable provision of services (if still applicable following completion of the baseline scenario selection analysis in Section B.4 above)

This section is not applicable, since all other alternative investments have been eliminated in section B.4 above.

- Continuation of the situation prior to the implementation of the proposed project activity

  Operation of plant with N_2O abatement catalyst only partially installed to just achieve compliance with the future plant-specific N_2O regulatory limit (which is most likely to be 2.5kg $N_2O/tHNO_3$ until 30th June 2012 and 1.85kg $N_2O/tHNO_3$ thereafter, as indicated in section B.4 above)

The proponent must then establish that the project activity could not be undertaken:

- Either because the economic incentives at the time of submission of the project dossier are insufficient to guarantee a return on investment as high as that resulting from the alternative investments (Step 2 of section 3.2 of the methodology “Catalytic reduction of N_2O at nitric acid plants”) ;
- Or because only the receipt of Emission Reduction Units (ERUs) would allow the proponent to overcome the barriers that prevent the necessary investments being undertaken (step 3 of 3.2 of the methodology “Catalytic reduction of N_2O at nitric acid plants”).

  The project proponent may chose to complete either Step 2 or Step 3.

The project participants have chosen to complete step 3 of section 3.2 of the methodology “Catalytic reduction of N_2O at nitric acid plants” in order to demonstrate the project’s additionality, since only the revenues from the sale of ERUs would encourage the implementation of the project activity. Step 2 of section 3.2 of the methodology “Catalytic reduction of N_2O at nitric acid plants” is therefore not applicable.

Barrier analysis Step 3 of Section 3.2 of the methodology “Catalytic reduction of N_2O at nitric acid plants”)

The barrier analysis in this section of the addtionality discussions is limited to a comparison of the identified Business as Usual scenario with the intended project activity. In the case where the proponents choose not to undertake Step 2 of section 3.2 of the methodology “Catalytic reduction of N_2O at nitric acid plants”, they must complete a full and documented analysis of all types of barriers, demonstrating that they limit or prevent to a large extent the implementation of the project activity, notably ;

- Investment barriers :

The proposed project activity aims to install two full batches of secondary catalyst technology at the plant and to operate the catalyst throughout the crediting period. In order to assess the project emissions, two Automated Monitoring Systems (AMS) have to be installed and operated. Pardies’s initial expenses included the delivery and handling of the catalyst, but they actually received the first batch of additional catalyst material itself free of charge from Ambès. However, top-ups of this catalyst material will be required every year for the duration of the project in order to maintain maximum abatement efficiency, at a cost of €100/kg. In addition to the increased investment for catalyst to achieve maximum abatement efficiency, YARA Pardies employees and management will have a significant additional work load to cope with in order to initiate the project activity and maintain it for the project's lifetime. Beginning with the necessary adjustments to the burner baskets to accommodate the additional catalyst, the required training for AMS operation has to be undertaken by the responsible staff, AMS calibration and other Projet Domestique-related audits have to be arranged, facilitated and paid for. Also, the catalyst pellets will have to be replaced more frequently if continuously low emissions are to be achieved, since the efficiency decreases during the catalyst's lifetime.

All these measures entail significant investment requirements. See table 1 in Annex 4 for full details of these investment requirements. All the costs shown in this table are specifically associated with the implementation of the project.

As previously assessed, Pardies currently has no need to make any further investment to decrease its N_2O emissions beyond the likely 2.5kg $N_2O/tHNO_3$ limit to be applied by the future plant-specific 'arrêté préféctoral'. Surplus emission reductions beyond this regulatory limit through installation of increased catalyst loads would be avoided in order to avoid extra costs.

None of the N_2O destruction technology options (including NSCR) are expected to generate any significant financial or economic benefits other than JI related income. Stage 2 in section 4 of the methodology « Catalytic reduction of N_2O in nitric acid plants » states « in the particular case of nitric acid plants, the N_2O tax[28] does not provide any incentive for the project participants to install N_2O reduction technology and does therefore not need to be considered in the financial assessment».

Only the revenues from ERU sales would therefore be sufficient to pay back the investment costs of the project activity. The registration of the project activity as a Projet Domestique is therefore the decisive factor for the realisation of the proposed project activity.

- Technological barriers:

During the phase of industrial testing of the catalyst, the YARA management decided not to fill the catalyst containment systems to their maximum capacity due to potential operational problems associated with installing increased loads of abatement catalyst. The greater the bed depth of catalyst installed inside the burners, the more likely it will be that the plant encounters problems associated with pressure drop. This may affect the gas flow through the burners, potentially lowering nitric acid production yields. Additionally, the heavier the loads of catalyst, the stronger must be their supporting containment structures and the more technical modifications will need to be made.

Therefore, revenues from the sale of ERUs provide the only incentive for the plant managers to confront these increased technical risks and install greater catalyst loads.

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[28] Payable in accordance with article 45 of the 'Loi de Finances 1999' and article 266 nonies of the 'Code des Douanes'

- Common practice barriers:

Market studies (e.g. by EFMA, EU IPPC, US EPA, IPCC) show that N_2O abatement technologies are not yet widely applied in the nitric acid industry even in Annex 1 countries, apart from in occasional industrial testing programmes. The main reason for this is a lack of regulation / incentive to reduce N_2O emissions.

The research and development work done so far has been driven by a general expectation that industrialised countries – especially the EU, USA, Japan and Canada – may eventually introduce N_2O emission caps. EU legislation initiating such a limit is under way already and will probably be introduced in the near future[29].

Before now, with the exception of the 3 plants that have taken part in industrial trials, the common practice in the country is to operate such facilities without any N_2O abatement technology. This situation is now changing, since other nitric acid plant operators in the region are also planning to implement N_2O abatement technologies as project activities under Projet Domestique.

Therefore, the analysis of the common industrial practice indicates that the proposed project activity is additional to the reference scenario.

Conclusion:

Pardies currently has no need to make any further investment to decrease its N_2O emissions beyond the likely 2.5kg $N_2O/tHNO_3$ limit to be applied by the future plant-specific 'arrêté préféctoral' and below the 1.85kg $N_2O/tHNO_3$ limit proposed for the period following 30th June 2012. Without the sale of the ERUs generated by the project activity there would be no incentive to justify the additional cost and technical risks associated with the implementation of the project activity. The project activity would not take place without the revenues from the sale of ERUs and therefore Projet Domestique registration is the decisive factor for the realisation of the proposed project activity.

The proposed Projet Domestique activity is additional, since it passes all the steps of the Additionality assessment.

B.6. Emission Reductions

B.6.1. Explanation of methodological choices

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Estimation of Verification Period specific project emissions

The project emission factor is assessed based on measurements of N_2O concentration in the stack gas ($NCSG_n$) and gas volume flow in the stack (VSG_n) conducted throughout any period of time for which the project proponents decide to undertake a Verification (the

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[29] See footnote 27 for detailed information.

"Verification Period"). Project proponents are free to decide what period of time they would like to define as a Verification Period as long as the following pre-requisites are met:

- The first Verification Period commences with the crediting period starting date.
- Any Verification Period after the first will start at the termination date of the previous Verification Period.
- No Verification Period may exceed the crediting period ending date.

Over the duration of the project activity, N_2O concentration and gas volume flow in each of the two stacks of the nitric acid plant, as well as the total nitric acid production of the plant will be measured continuously and a **Project Emission Factor (EF_n)** – given as $kgN_2O/tHNO_3$ – can be established at any given time for any period of time.

Higher N_2O emissions during the project's lifetime will lead to a reduced amount of ERUs issued. For this reason, the methodology "Catalytic Reduction of N2O at Nitric Acid Plants" has not provided measures against any abusive practices (contrary to CDM methodology AM0034). Project operators will be sufficiently incentivised to run their plants at emission levels as low as possible in order not to lose ERU-revenues. In case a plant is emitting more N_2O than the Benchmark Emissions Factor, no additional environmental consequences are to be feared, as the only effect from this would be that the project activity will not generate any ERUs during such times[30] that will become available to carbon markets.

For these reasons, it is not relevant for which period of the plant's production cycle ERUs are claimed.

Measuring of N_2O data sets for the calculation of project emissions

Throughout the project's crediting period, N_2O concentration ($NCSG_n$) and volume flow in the stack gas (VSG_n) are to be monitored. The monitoring systems will provide separate hourly average values for $NCSG_n$ and VSG_n based on continuous readings. These N_2O data sets (consisting of $NCSG_n$ and VSG_n average values for each operating hour) can be identified by means of a unique time / date key indicating when exactly the values were observed.

During the crediting period, the following additional data has to be monitored:

- The operating hours (OH_n) as recorded by the plant's process control system and the nitric acid production output (NAP_n) are required for calculating the project emissions.

Because the reference Benchmark Value (unlike the Emissions Factor Baseline EF_{BL} in AM0034) is not determined based on certain plant operating parameters, there is no need to monitor those plant operating parameters and establish the comparability of the two data sets by adjusting the EF_{BM} for each Verification Period.

Measurement of NAP

The nitric acid at Pardies is produced in three separate concentrations:

- 53% concentration, which is used as a raw material for the production of Ammonium Nitrate on-site at Pardies
- 63% concentration, which is exported to customers
- 100% concentration, which is sold for nitration

The calculation of nitric acid produced at Pardies is based on three separate sources. The results are compared with one another to ensure consistency and detect any deviations:

- One Flexim mass flow meter is installed on each of the three concentration streams. The total HNO_3 production is then calculated for 100% concentration by multiplying the mass flow by the concentration of each stream.
- Stoichiometric calculation using the ammonia consumption of the AORs and the conversion and absorption efficiencies
- Variations in the nitric acid storage levels, considering the consumption and loading values for each product

Missing data

During downtime of the AMS or other interruption of measurement during part of one hour, the hourly average will be calculated based on the remaining values for the rest of the hour in question. If these remaining values account for less than 50% of the hourly data for one or more parameters, then this hour must be eliminated from the calculation. Each time it is impossible to calculate an hour of valid data, substitute values will be defined in accordance with the following rules:

i. *Concentrations*

In the case where it is impossible to obtain an hour of valid data for a parameter whose concentration is directly measured (GHG, O_2 etc), a substitute value (C*subst) must be calculated for the hour in question, as follows:

C*subst = C + σC_

where:

C: arithmetic mean of the concentration of the relevant parameter

σC_: Best estimate of the standard deviation of the concentration of the relevant parameter

The arithmetic mean and the standard deviation are calculated at the end of the relevant verification period on the basis of all emissions data measured during that period.

The calculation of the arithmetic mean and the standard deviation must be presented to the verifier.

ii. Other parameters

In the case where it is impossible to obtain an hour of valid data for a parameter whose concentration is not directly measured, substitute values must be calculated using a mass balance or energy balance calculation. Other measured parameters that are used in the calculation of the emissions will be used to validate the results. The mass balance or energy balance calculation, and the theories on which they are based, must be clearly explained and presented to the verifier at the same time as the calculated results.

Data processing in case of malfunction of the abatement system

In order to take into account problems that may occur with the catalyst, all gas volume flow and N_2O concentration values recorded during periods where the N_2O concentration exceeds a value (expressed in mg/Nm3) equivalent to 2.5 kgN_2O/tHNO_3, (to be determined by the project proponent and identified during the verification) will be excluded from the calculation of the project emissions factor and no ERUs shall be claimed for the corresponding quantities of nitric acid produced during those operating hours.

Furthermore, if the missing data corresponds to a period of failure of the abatement technology, one should adopt the principle that the emissions have not been treated by the abatement technology during the whole of the hour in question and that substitute values have been calculated as a result.

Measurement during standard plant operation

Only those data sets collected during normal operation of the plant shall be used as a basis for determining the Verification Period specific project emissions. Most plants have one or more trip point values, normally defined by the manufacturer and specified in the plant's operating manuals. At Pardies, the plant's operational status can be determined by whether or not NH_3 is still flowing into the AOR. When the ammonia valve status signal indicates that the plant's ammonia valve is closed, the plant is considered to be off-line. In addition, the trip point values for oxidation temperature and ammonia to air flow ratio will be used for the purposes of a plausibility check. If one of these parameters is outside the range specified by the trip point values, the plant should automatically shut down.

Consequently, all NCSG and VSG data sets recorded at times when the plant was considered to be out of operation must automatically be excluded from the calculation of project N_2O emissions. The number of operating hours (OH_n) will be reduced accordingly. However, the number of tonnes of nitric acid produced (NAP_n) will not be adjusted. This is because the HNO_3 flow measured in the period immediately following a plant trip represents the flow of the nitric acid that was remaining in the absorption column after the trip and was actually produced before the plant shutdown. This quantity of HNO_3 is therefore associated with a period when the plant was functioning within its normal operating parameters and must therefore be included in the calculation of NAP_n.

For the avoidance of doubt, data sets containing values beyond the range of the specified trip point values are not to be regarded as AMS downtime readings (as defined above).

Application of instrument correction factors / elimination of implausible values

The correction factors derived from the calibration curve of the QAL2 audits for all components of the AMS, as determined during the QAL2-tests in accordance with EN14181, must be applied onto both VSG and NCSG, unless these were already automatically applied to the raw data recorded by the data storage system at the plant.

For all N_2O data sets a plausibility check is conducted in accordance with current best practice monitoring standards. All data sets containing values that are implausible are eliminated.

Any implausible data (for example during plant shut-down or AMS downtime) and any extreme values are to be automatically eliminated using the following statistical procedure:

(a) Calculate the sample mean (x);

(b) Calculate the sample standard deviation(s);

(c)Calculate the 95% confidence interval (equal to 1.96 times the standard deviation);

(d) Eliminate all data that lie outside the 95% confidence interval;

(e) Calculate the new sample mean from the remaining values

Permitted overall uncertainty

For each emission source, the permitted overall uncertainty of the average hourly annual emissions must be less than 7.5%. The next level, and the maximum allowed, is 10%, which can only be applied if it can be proven to the satisfaction of the competent authority that the application of the 7.5% level is technically impossible to achieve or that it would entail excessive costs.

If the total established uncertainty is higher than the permitted overall uncertainty, the project-specific emissions are to be increased by the difference between the established uncertainty value and the permitted overall uncertainty value.

Example:

Permitted overall uncertainty value: 7.5%

Established overall uncertainty value: 10%

The total N_2O emissions during the Verification Period are increased by 2.5% (10% - 7.5%)

Calculation of the EF_n-value

The total mass of N_2O emissions in a Verification Period (PE_n) is the product of the remaining valid $NCSG_n$ and VSG_n-values multiplied by OH_n for each of the two lines.

The following equation is applied to the readings from each of the two AMS:

$$PE_n \text{ (line 1)} = VSG_n * NCSG_n * OH_n * 10^{-6} \qquad (kgN_2O)$$

+

PE_n (line 2)= $VSG_n * NCSG_n * OH_n * 10^{-6}$ (kgN_2O)

Once the total mass of N_2O emissions produced during the verification period has been calculated for each line using the equation above, the resulting figures are then added together to derive 'PE_n total', and divided by the total output of 100% concentrated nitric acid of the plant for that period. This results in the plant-specific project emissions factor, representing the average N_2O emissions per tonne of nitric acid over the respective Verification Period. The average N_2O emissions per metric ton of 100% concentrated nitric acid for the Verification Period (PE_n) shall then be calculated as follows:

$EF_n = (PE_n \text{ total}/ NAP_n)$ ($kgN_2O/tHNO_3$)

where:

Variable	Definition
PE_n	total N_2O emissions during the specific Verification Period (kgN_2O)
EF_n	Emissions factor used to calculate the emissions from the defined Verification Period n ($kgN_2O/tHNO_3$)
$NCSG_n$	Mean concentration of N_2O in the tail gas stream during the Verification Period (mgN_2O/m^3)
OH_n	Operating hours of the plant during the Verification Period (h)
VSG_n	Mean tail gas volume flow rate during the Verification Period (m^3/h)
NAP_n`	Nitric acid production during the Verification Period ($tHNO_3$)

Allocation of ERUs

The **emission reductions based on which ERUs will be issued** for the project activity are determined by deducting the project-specific emission factor from the Benchmark Value and multiplying the result by the production output of 100% concentrated nitric acid over the period for which ERUs are to be claimed and the GWP of N_2O, as shown in the calculation below. In addition, the Arrêté of 2 March 2007 states: "the total amount of issued Emission Reduction Units equates to 90% of the GHG emissions effectively avoided due to the implementation of the project activity".

$ERU = (EF_{BM} - EF_n)/1000 \times NAP_n \times GWP_{N2O} \times 0.9$ (tCO_2e)

Where:

Variable	Definition
ERU =	Emission reductions awardable to the project for the Verification Period (tCO_2e)
NAP_n =	Nitric acid production for the Verification Period n ($tHNO_3$).

EF_{BM} = Emissions Factor Benchmark according to host country approval ($kgN_2O/tHNO_3$); see section A.5 (last paragraph) of the PDD for further information.

EF_n = Emissions factor used to calculate the emissions from the defined Verification Period n ($kgN_2O/tHNO_3$).

GWP_{N2O} = Global Warming Potential: 310 tCO_2e/tN_2O

In accordance with the methodology, no leakage calculation is required, because the technology used is a secondary catalyst, not a tertiary. As such, neither ammonia nor hydrocarbons are used as reducing agents / for co-firing in the operation of the catalyst technology installed.

B.6.2. Data and parameters determined prior to validation

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The below tabular format follows the format specified in the France-specific PDD template, issued by the French DFP.

Table 4. Default factors

Data / Parameter	*Global Warming Potential of N2O*
Symbol	GWP_{N2O}
Unit	tCO_2e/tN_2O
Source	*Climate Change 1995, The Science of Climate Change: Summary for Policymakers and Technical Summary of the Working Group I Report, page 22.*
Applicable value	*310*
Justification of choice of value	*To comply with the requirements of the Kyoto Protocol*
Comments	*310 until 31st December 2012 and 298 from 1st January 2013.* *Subject to revisions in accordance with Art. 5 Kyoto Protocol.*

Data / Parameter	*Specific reference value (benchmark emissions factor) that will be applied to calculate the emissions reductions from a specific Verification Period*
Symbol	EF_{BM}
Unit	$kgN_2O/tHNO_3$
Source	*Determined according to French government decision (MEEDDM)*
Applicable value	*2.5kg* $N_2O/tHNO_3$ *until end 2011 and 1.85kg thereafter until end 2012*
Justification of choice of value	*Decision taken by the MEEDDM in April 2009*
Comments	*To be determined for each verification period in accordance with the host country decision. See section A.5 (last paragraph) of the PDD for additional information.* *Project proponents reserve the right to change the applicable values in the case where they may be subsequently revised by the MEEDAT.*

Data / Parameter	*Emissions cap for* N_2O *from nitric acid production set by government/local*

	regulation
Symbol	EF_{req}
Unit	$kgN_2O/tHNO_3$ *(converted, if necessary)*
Source	*Pardies plant-specific 'arrêté préféctoral', to be issued by the DRIRE sometime in 2010*
Applicable value	*Expected 2.5kg until 30th June 2012 and 1.85kg thereafter (as explained in Section B.3 above)*
Justification of choice of value	*Mandatory applicable limit*
Comments	*Continuous surveillance throughout crediting period.*

Table 5. Data and parameters determined prior to validation

Data / Parameter	*Maximum Ammonia Oxidation Temperature - trip point value*
Symbol	OT_{max}
Unit	*ºC*
Source	*Plant operating manuals*
Applied value	*890*
Description of methods used to obtain this value (measurements, calculations, procedures etc)	*Value taken from plant operating manuals*
Comments	

Data / Parameter	*Maximum Ammonia to Air Ratio – trip point value*
Symbol	$AIFR_{max}$
Unit	*%*
Source	*Plant operating manuals*
Applied value	*11.9*
Description of methods used to obtain this value (measurements, calculations, procedures etc)	*Value taken from plant operating manuals*
Comments	

B.6.3. Ex ante calculation of emission reductions

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Emission reductions achievable by the proposed project activity will be dependent on the amounts of nitric acid produced. In accordance with the methodology “Catalytic reduction of N_2O at nitric acid plants”, emission reductions are determined pro unit of product measured in metric tonnes of 100% concentrated nitric acid produced.

YARA Pardies has budgeted for the following production amounts:

Year	**Budgeted production ($tHNO_3$)**
2010 (Aug - Dec)	60,917
2011	146,200
2012	146,200
Following years	146,200

Table 6: Budgeted nitric acid production

Based on these production figures, one can make assumptions on how much N_2O would be emitted into the atmosphere during the project activity. As described in section A.5 above, a benchmark value will be applied for calculating the ERUs to be awarded for the project. The project proponents will only receive ERUs for the difference between the applicable benchmark value and the emission levels of the project activity.

Estimated project emissions (compared to operation without N_2O catalyst)

Accordingly, the **following assumptions** apply to the establishment of the emissions reductions:

- The project activity will become eligible to receive ERUs on receipt of the official government LoA (or two months following submission of project dossier, whichever is the earlier). Final approval is expected by the end of July 2010 and so the official date of project commencement is estimated to be 1st August 2010.
- YARA Pardies produces the amounts of nitric acid according to the production budget provided above, each year’s production being equally distributed throughout the period;
- Factual emissions from the plant without any abatement catalyst would be $5.7kgN_2O/tHNO_3$[31];
- The secondary catalyst employed performs with an abatement efficiency of 95% throughout the project’s lifetime (resulting in project emissions of 0.285kg $N_2O/tHNO_3$). This estimate is based on data measured at the plant with the new, QAL2-tested Automated Monitoring System (AMS). The QAL 2 uncertainty percentage was then added to the average ppm concentration for the sake of achieving a more conservative estimate. This data has been checked by the

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[31] See footnote 3 for more detailed information

responsible AIE and shows that the abatement efficiency is currently higher than 95%.

Using the above assumptions, the following emissions are estimated for the Project Activity:

Crediting Period Year	**Project Emissions (tCO_2e)**
2010 (Aug - Dec)	5,382.0
2011	12,916.8
2012	12,916.8
TOTAL (until 2012)	**31,216**

Table 7 (part A): Project emissions until 2012

Crediting Period Year	**Project Emissions (tCO_2e)**
2013	12,416.8
2014	12,416.8
2015	12,416.8
2016	12,416.8
2017	12,416.8
2018	12,416.8
2019	12,416.8
TOTAL (over 10 year crediting period)	**118,133**
Average (over 10 year crediting period)	**11,813**

Table 7 (part B): Project emissions from 2013 onwards.

* Due to the likely inclusion of N_2O emissions from nitric acid production into the EU ETS from 1st January 2013 onwards, the project may not be eligible to earn ERUs after that time, or continuing the project under the JI may not be economically viable. Also, from 2013 onwards a GWP of 298 for N_2O as defined by the IPCC Third Assessment Report will be applied. This is why this PDD differentiates between prospective emission reductions achieved until 31st December 2012 and emissions reductions generated from 1st January 2013 onwards.

Reference Scenario (benchmark) emissions

Since a Benchmark Value must be applied to the project[32], calculated reference emissions are represented through the value 2.5 $kgN_2O/tHNO_3$ until end of December 2011 and the value 1.85kg $kgN_2O/tHNO_3$ from the 1st January until end of December 2012.

The benchmark value that would be applicable from 1st January 2013, in the case where a project would still be feasible, is unknown. In order to ensure a conservative estimate of the number of emissions reductions achievable during the crediting period, we will assume a tentative benchmark level of 1.5kg. This future level is purely speculative. It is more appropriate than any other figure, simply for the reason that 1.5kg was mentioned by the MEEDDM during discussions in April 2009 as an example of a possible limit for N_2O emissions from 2013.

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[32] See section A.5 (last paragraph) of the PDD for additional information.

Crediting Period Year	**Benchmark Scenario Emissions (tCO_2e)**
2010 (Aug - Dec)	47,210.4
2011	113,305.0
2012	83,845.7
TOTAL (until 2012)	**244,361**

Table 8 (part A): Reference scenario (benchmark) emissions until 2012

Crediting Period Year	**Benchmark Scenario Emissions (tCO_2e)**
2013	65,351
2014	65,351
2015	65,351
2016	65,351
2017	65,351
2018	65,351
2019	65,351
TOTAL (over 10 year crediting period)	**701,821**
Average (over 10 year crediting period)	**70,182**

Table 8 (part B): Hypothetic reference scenario (benchmark) emissions from 2013 onwards.

* Due to the likely inclusion of N_2O emissions from nitric acid production into the EU ETS from 1st January 2013 onwards, the project may not be eligible to earn ERUs after that time, or continuing the project under the JI may not be economically viable. Also, from 2013 onwards a GWP of 298 for N_2O as defined by the IPCC Third Assessment Report will be applied. This is why this PDD differentiates between prospective emission reductions achieved until 31st December 2012 and emissions reductions generated from 1st January 2013 onwards.

B.6.4. Summary of ex ante estimate of emission reductions

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Year	**Estimate of project activity emissions** (tonnes of CO_2e)	**Estimate of Benchmark scenario emissions** (tonnes of CO_2e)	**Leakage estimate** (tonnes of CO_2e)	**10% gvt ERU deduction** (tonnes of CO_2e)	**Estimate of final emission reductions** (tonnes of CO_2e)
2010 (Aug - Dec)	5,382.0	47,210.4	N/A	4,182.8	37,646
2011	12,916.8	113,305.0	N/A	10,038.8	90,349
2012	12,916.8	83,845.7	N/A	7,092.9	63,836
Total (tonnes of CO_2e)	**31,216**	**244,361**		**21,314.6**	**191,831**

Table 9. Summary of estimation of emission reductions

B.7. Application of the monitoring methodology and description of monitoring plan

B.7.1. Measured data and parameters

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Table 10. Data and parameters measured during the project activity

Data / Parameter P.1	*Average N_2O concentration in the tail gas during project Verification Period n.*
Symbol	$NCSG_n$
Unit	mgN_2O/Nm^3 *(converted from ppm if necessary)*
Source	*Dr. Födisch MCA 04 Continuous Emissions N_2O Analysers (part of AMS)*
Measurement Frequency	*Hourly average value based on continuous monitoring*
Value applied for emissions reductions calculations in section B.6.	*Not applicable. All ex ante emission reduction calculations in this PDD are based on estimated figures.*
Applied measurement procedures	*Automatic continuous measurement with MCA 04 hot extractive analysers*
Applied quality assurance and control procedures	*AMS is subject to regular checking and calibrations that will take place according to vendor specifications and EN14181*
Comments	

Data / Parameter P.2	*Average Volume flow rate of the tail gas during project Verification Period n.*
Symbol	VSG_n
Unit	Nm^3/h
Source	*Dr. Födisch FMD 99 gas volume flow meters (part of AMS)*
Measurement Frequency	*Hourly average value based on a continuous monitoring*
Value applied for emissions reductions calculations in section B.6.	*Not applicable. All ex ante emission reduction calculations in this PDD are based on estimated figures.*
Applied measurement procedures	*Monitored continuously with FMD 99 pressure-differential flow meters*
Applied quality assurance and control procedures	*AMS is subject to regular checking and calibrations that will take place according to vendor specifications and EN14181*
Comments	*The data output from the tail gas flow meter will be processed using the plant's Aspentech 'Info Plus 21' data collection and storage system.* *Corrected for standard conditions (273,15 °K, 1013, 25 hPa) using TSG*

	(P.10) and PSG (P.11) data.

Data / Parameter P.3	*N_2O emissions during project Verification Period for each line n.*
Symbol	PE_n
Unit	kgN_2O
Source	*Calculation from measured data*
Measurement Frequency	*Calculated after Verification Period has been defined by the project proponents*
Value applied for emissions reductions calculations in section B.6.	*Not applicable. All ex ante emission reduction calculations in this PDD are based on estimated figures.*
Applied measurement procedures	*Not applicable, calculated value as per the following formula:* $PEn = VSG * NCSG * OH * 10^{-6}$
Applied quality assurance and control procedures	*Not applicable*
Comments	

Data / Parameter P.4	*Total operating hours of Verification Period for each line*
Symbol	OH_n
Unit	*Hours*
Source	*Production Log – taking into account: plant status signal, NH3 valve status signal, trip point parameters*
Measurement Frequency	*Continuous*
Value applied for emissions reductions calculations in section B.6.	*Not applicable. All ex ante emission reduction calculations in this PDD are based on estimated figures.*
Applied measurement procedures	*Plant manager records the hours of full operation of each line of the plant on continuous basis.*
Applied quality assurance and control procedures	*Not applicable*
Comments	*May be amended according to trip point values (see section B.6.1 above).*

Data / Parameter P.5	*Metric tonnes of 100% concentrated nitric acid during any Verification Period*
Symbol	NAP_n
Unit	$tHNO_3$
Source	*Measurements from three sources :* - *Flexim Mass flow meters for each concentration stream* - *Stoichiometric mass balance calculation* - *Nitric acid storage levels*

Measurement Frequency	*Continuously throughout the Verification Period*
Value applied for emissions reductions calculations in section B.6.	*Not applicable. All ex ante emission reduction calculations in this PDD are based on estimated figures.*
Applied measurement procedures	*Measured (flow meters and tank levels) and calculated (Mass balance calculation)*
Applied quality assurance and control procedures	*Checked during regular plant maintenance in accordance with the relevant quality assurance requirements.*
Comments	

Data / Parameter P.6	*Oxidation temperature in the two ammonia oxidation reactors (AORs).*
Symbol	*OT (2 values – 1 per burner)*
Unit	*℃*
Source	*Thermocouples inside the two AORs.*
Measurement Frequency	*Hourly average value for each burner based on continuous monitoring*
Value applied for emissions reductions calculations in section B.6.	*Not applicable. All ex ante emission reduction calculations in this PDD are based on estimated figures.*
Applied measurement procedures	*Measured*
Applied quality assurance and control procedures	*Checked during regular plant maintenance.*
Comments	

Data / Parameter P.7	*Ammonia Flow rate to the two ammonia oxidation reactors (AORs)*
Symbol	*AFR (2 values – 1 per burner)*
Unit	kgNH_3/h
Source	*Ammonia flow meters*
Measurement Frequency	*Hourly average value for each burner based on continuous monitoring*
Value applied for emissions reductions calculations in section B.6.	*Not applicable. All ex ante emission reduction calculations in this PDD are based on estimated figures.*
Applied measurement procedures	*Measured.*
Applied quality assurance and control procedures	*Checked during regular plant maintenance.*
Comments	

Data / Parameter P.8	*Ammonia to air ratio going into the two ammonia oxidation reactors (AORs)*
Symbol	*AIFR (2 values – 1 per burner)*
Unit	*%*
Source	*Ammonia & Air flow meters*
Measurement Frequency	*Hourly average value per burner based on continuous monitoring*
Value applied for emissions reductions calculations in section B.6.	*Not applicable. All ex ante emission reduction calculations in this PDD are based on estimated figures.*
Applied measurement procedures	*Monitored & calculated*
Applied quality assurance and control procedures	*Checked during regular plant maintenance.*
Comments	

Data / Parameter P.9	*Temperature of tail gas for each stack*
Symbol	*TSG (2 values – 1 per stack)*
Unit	*℃*
Source	*Probe (part of the FMD 99 gas volume flow meter).*
Measurement Frequency	*Hourly average value based on continuous monitoring*
Value applied for emissions reductions calculations in section B.6.	*Not applicable. All ex ante emission reduction calculations in this PDD are based on estimated figures.*
Applied measurement procedures	*Monitored.*
Applied quality assurance and control procedures	*AMS is subject to regular checking and calibrations that will take place according to vendor specifications and EN14181*
Comments	*May not be recorded, if AMS / data storage system adjusts flow measurements to standard conditions automatically*

Data / Parameter P.10	*Pressure of tail gas for each stack*
Symbol	*PSG (2 values – 1 for each stack)*
Unit	*Pa*
Source	*Probe (part of the AMS gas volume flow meter).*
Measurement Frequency	*Hourly average value based on continuous monitoring*
Value applied for emissions reductions calculations in section B.6.	*Not applicable. All ex ante emission reduction calculations in this PDD are based on estimated figures.*
Applied	

measurement procedures	*Monitored. Alternatively, a default value will be applied in case of stack pressure conditions with little variation. The default value will be determined by the auditor during the QAL2 audit in accordance with EN14181.*
Applied quality assurance and control procedures	*AMS is subject to regular checking and calibrations that will take place according to vendor specifications and EN14181*
Comments	*May not be recorded, if AMS / data storage system adjusts flow measurements to standard conditions automatically*

Data / Parameter P.11	*Emissions factor calculated for project Verification Period n*
Symbol	EF_n
Unit	kgN_2O / $tHNO_3$
Source	*Calculated from measured data following procedures detailed in B.6.1*
Measurement Frequency	*After each Verification Period*
Value applied for emissions reductions calculations in section B.6.	*Estimated Project Emission factor is: 0.285* $kgN_2O/tHNO_3$ *(based on 95% abatement efficiency from a level of 5.7kg prior to the installation of any catalyst)*
Applied measurement procedures	*The Verification Period specific emissions factor for each Verification Period during the project's crediting period is calculated by adding together th total mass of N2O emissions for each of the two lines during that Verification Period and dividing that result by the total production of 100% concentrated n acid from the plant during that same Verification Period.* *For Verification Period n the emission factor would be:* $EFn = (PEn\ total / NAPn)$ $(kgN_2O/tHNO_3)$
Applied quality assurance and control procedures	
Comments	

Data / Parameter P.12	*Emissions cap for* N_2O *from nitric acid production set by government/local regulation*
Symbol	EF_{reg}
Unit	kgN_2O / $tHNO_3$ *(converted if necessary)*
Source	*Pardies 'arrêté préféctoral', to be issued by the DRIRE in the very near future*
Measurement Frequency	*After each Verification Period*
Value applied for emissions reductions calculations in section B.6.	*Expected: 2.5kg until 30th June 2010 and 1.85kg thereafter (based on a propo regulation from the local préfet in May 2010).*
Applied measurement procedures	*If this regulatory limit is ultimately LOWER than the applicable benchmark emissions factor, then* EF_{reg} *shall replace* EF_{bm} *in the calculation of ERUs:* $ERU = (EF_{reg} - EF_n)/1000 \times NAP_n \times GWP_{N2O}$ (tCO_2e)
Applied quality	

assurance and control procedures	
Comments	

B.7.2. Description of the monitoring plan

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The emissions reductions achieved by the project activity will be monitored in accordance with sections 4, 5 and 6 of the projet domestique methodology “Catalytic reduction of N_2O at nitric acid plants” as prepared by N.serve Environmental Services GmbH, Germany, and Rhodia Energy Services, France.

The above methodology requires the project participants to install and maintain automated monitoring technology in accordance with the latest European or national standards and norms (for example, either the European Norm EN14181, the French AFNOR standard XP X43-305, as applicable, or any other monitoring standard considered acceptable in accordance with the requirements for assessing plant emissions in order to calculate payable N_2O tax[33] , always in their most up-to-date versions, including any applicable successor standards as valid at the time of project application). N.serve has chosen to use European Norm EN14181 (2004) *“Stationary source emissions - Quality assurance of automated measuring systems”*[34] as a guidance for installing and operating the Automated Monitoring Systems (AMS) at Yara Pardies for the monitoring of N_2O emissions.

Two Automated Measuring Systems (AMS) consisting of the following shall be used for monitoring in the two tail gas stacks:

- An automated gas analyzer system that will continuously measure the concentration of N_2O in the tail gas of the plant; and
- A gas volume flow meter that uses differential-pressure technology to continuously monitor the gas volume flow, temperature and pressure, in the tail gas of the plant.

Sampling shall be carried out continuously in the two stacks using two multiple-point sampling tubes that are optimised to the specific width and height of the tail gas ducts, and the expected gas velocities in the tail gas. Temperature and pressure in the tail gas will also be measured continuously and used to calculate the gas volume flow at standard conditions.

Description of the AMS to be installed at YARA Pardies nitric acid plant.

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[33] Payable in accordance with Article 45 of the Loi de Finances 1999 and Article 266 nonies of the Code des Douanes

[34] This standard describes the quality assurance procedures needed to assure that an Automated Measuring System (AMS) installed to measure emissions to air are capable of meeting the uncertainty requirements on measured values given by legislation, e.g. EU Directives, or national legislation, and more generally by competent authorities.

1. General Description of the AMS

At the end of August 2009, the plant at Yara Pardies was equipped with two state-of-the-art hot extractive AMS, each consisting of a Dr. Födisch MCA 04 Continuous Emissions Analyser, a sample probe, heated filter and heated sample-line connected directly to the analyser and a Dr. Födisch FMD 99 Stack Gas Flow meter. The plant has an Aspentech 'Info Plus 21' data collection and storage system, which has been programmed to log and store raw data for the duration of the project activity.

Since this nitric acid plant has been in operation since 1960, YARA Pardies staff in general and its instrument department in particular are accustomed to operating technical equipment adhering to high quality standards.

The following staff at the nitric acid plant will be principally responsible for the ongoing operation of the project and for the quality assurance and maintenance of the N_2O monitoring system:

Philippe Michiels	Plant Manager
Philip Bault	Instrumentation & Electricity Manager
Bernard Guillou	HESQL Manager

Operation, maintenance and calibration intervals will be carried out by staff from the instrument department according to the vendor's specifications and under the guidance of internationally relevant environmental standards, in particular EN 14181 (2004). Service will be performed by the supplier of the AMS.

All monitoring procedures at YARA are also conducted and recorded in accordance with the procedures under ISO 9001:2000, which is regularly audited by certified independent auditing organisation accredited for ISO 9001 certification.

2. Sample points

The sample points were chosen in accordance with the AMS requirements, EN 14181 requirements and the plant design specifications to ensure optimum quality of the collected data. The most suitable location for the sample points for the measurement of N_2O [NCSG] and tail gas flow [VSG] is the tail gas stack downstream of all process equipment, at a point where the temperature is less than 300℃ (N_2O is known to decompose at temperatures above 300℃). There will be a 7m straight section of undisturbed pipe before the sampling points and a 3m straight section afterwards.

3. Analyser

The Dr. Födisch MCA 04 Continuous Emissions Analysers are capable of analysing N_2O concentration in gas mixtures. The analysis system MCA 04 is an extractive, continuous measuring system. The analysis system MCA 04 extracts a partial gas flow from the flue gas, which is led to the analyser through a heated line (all heated components of the measuring system are regulated at 185 ℃). This state of the art gas sampling and conditioning system and the most advanced photometer technology ensure high reliability and long operating times with short maintenance intervals.

The MCA 04 is a single beam photometer. It is based on the absorption of infrared light. For the calculation of a component's concentration, the measuring technology registers unattenuated and attenuated intensity in the range of absorption wavelengths. For the measurement of N_2O, Gas filter correlation technique is used.

According to EN 14181, the Analysers are QAL1[35] tested for the measurement of all standard components that usually are measured in the waste gas of large combustion plants, waste incineration plants or mechanical biological waste treatment plants. The QAL1 tested components are: CO, NO, SO_2, HC_l, NH_3, H_2O. The QAL1 test for N_2O is currently ongoing and is expected to be completed in the near future. In any case, the use of a QAL1-tested analyser is not a mandatory requirement of the methodology applied.

QAL2 audits were successfully performed by an independent laboratory with EN ISO/IEC 17025 accreditation in February 2010.

A hot extractive analyser was chosen in order to address a particular safety concern. Since the analysers are installed downstream of the SCR units, where ammonia is used for NO_x abatement purposes, there is a possibility of the formation of ammonium nitrate/nitrite. In case of a cold measurement system as usually applied in other plants, it is possible that, due to the low temperature in the gas cooler and the analyser, solid nitrate/nitrite deposits could block the sampling lines, harm the analyser and in the worst case lead to explosions during maintenance works. In case of the MCA 04 analyser, all parts of the system that come into contact with the waste gas are heated well above 180℃. Therefore, no solid deposits of nitrate/nitrite are possible. At the moment no QAL1 tested NDIR-Analyser for N_2O is available on the market that fulfils the requirements of hot measurements according to the YARA internal safety rules.

4. Sample Conditioning System

As the gas sample is extracted, particles are removed with a heated filter unit at the sampling point and the clean sampling gas is delivered through a heated sampling line directly to the analyser in its cabinet, via the sampling pump. The temperature of the sampling gas is always maintained at 185 ℃. The minimum flow rate to the analyser is controlled and connected to a general alarm, which in turn is connected to the data acquisition system.

5. Flow Meter

The Dr. Födisch FMD 99 measuring systems allow continuous determination of the flow rate of stack gas. They are type-tested to the guidelines of the German Federal Ministry for the Environment, Nature Conservation and Reactor Safety on suitability testing of measuring equipment for continuous measuring of emissions[36].

The flow measuring device FMD 99 is a highly sensitive system for continuous, in-situ flow measurement. The differential pressure is continuously measured via the dynamic pressure probe of the FMD 99.

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[35] TÜV Immissionsschutz und Energiesysteme GmbH, Köln TÜV Rheinland Group Report No. 936/21203173/A vom 13. Juli 2005

[36] TÜV Rheinland Sicherheit und Umweltschutz GmbH, Köln (report number 936/808 005/C vom 18. Februar 2000) and TÜV Immissionsschutz und Energiesysteme GmbH, Köln (report number 936/rö vom 15. Oktober 2003).

The signal resulting from the differential pressure is a degree of the velocity respective to the flow of the exhaust gas. The FMD 99 also conducts the internal measurement of the absolute stack gas pressure (PSG) and the stack gas temperature (TSG).

Linking these devices with the Aspentech ‘Info Plus 21’ data acquisition system, the data flows can be converted from operating to standard conditions, taking into account the other flow parameters such as temperature and pressure.

6. The data acquisition system

The YARA Pardies nitric acid plant is equipped with an Aspentech ‘Info Plus 21’ data collection and storage system that will collect and store all the values for NCSG, VSG, TSG and PSG, as well as different status signals of the AMS and the NH_3 valve status signal from the nitric acid plant that defines whether or not the plant is in operation.

7. Data evaluation

The nitric acid plant operator derives hourly averages for all of the monitored parameters from the plant-specific data management system. This data is exported to EXCEL-format and delivered by email or on CD to N.serve by the plant operator. N.serve is responsible for the correct analysis of the delivered data in accordance with the PDD.

At N.serve the received data is stored on the N.serve fileserver in a special section for the storage of monitoring data separately for each project. The files are protected against manipulation by a password. Martin Stilkenbäumer at N.serve is responsible for the correct data handling and processing.

After a first plausibility check the data is transferred to a special data bank system. All necessary calculations and necessary steps of data analysis of the monitored data are carried out by N.serve using the data bank tool in accordance with the regulations and requirements of the methodology “Catalytic reduction of N_2O at nitric acid plants”, as outlined in this PDD.

The results of the data analysis are transferred to an Excel spreadsheet. The results are used for calculation of project emissions, as well as for the preparation of the Monitoring Reports.

8. AMS QA procedures

The following section describes how the procedures specified in EN14181 for QAL1, 2 and 3 have been adapted and are practically applied at the YARA Pardies nitric acid plant.

QAL 1

In accordance with EN14181, the selected AMS shall have been proven suitable for their measuring task (parameter and composition of the flue gas) by use of the QAL1 procedure as specified by EN ISO 14956. This standard’s objective is to prove that the total uncertainty of the results obtained from the AMS meets the specification for uncertainty stated in the applicable regulations. Such suitability testing has to be carried out under specific conditions by an independent third party on a specific testing site.

A test institute shall perform all relevant tests on the AMS. The AMS have to be tested in the laboratory and field.

The chosen Dr. Födisch MCA 04 gas analysers are QAL1[37] tested for the measurement of all standard components that usually are measured in the waste gas of large combustion plants, waste incineration plants or mechanical biological waste treatment plants. The QAL1 tested components are: CO, NO, SO_2, HC_1, NH_3, H_2O. The QAL1 test for N_2O is currently ongoing and is expected to be completed in the near future. The QAL2 audits were successfully performed by an independent laboratory with EN ISO/IEC 17025 accreditation in February 2010.

Hot extractive analysers were chosen in order to address a particular safety concern regarding possible formation of Ammonium Nitrate/Nitrite. As described above in section B.7.2. (3), this is a YARA internal safety precaution.

The chosen Dr. Födisch FMD 99 stack gas flow meter has fulfilled the requirements of the QAL1 and was successfully tested by TÜV Rheinland Sicherheit und Umweltschutz GmbH, Köln, Germany[38]

QAL2

QAL2 is a procedure for the determination of the calibration function and its variability, and a test of the variability of the measured values of the AMS compared with the uncertainty given by legislation. The QAL2 tests are performed on suitable AMS that have been correctly installed and commissioned on-site (as opposed to QAL 1, which is conducted off-site). QAL2 tests are to be performed at least every 3 years according to EN 14181.

A calibration function is established from the results of a number of parallel measurements performed with a Standard Reference Method (SRM). According to EN14181, the QAL2 test, including the SRM, needs to be conducted by an independent “testing house” or laboratory, which has to be accredited to EN ISO/IEC 17025. The QAL2 tests were conducted in February 2010 and the full QAL 2 reports were issued in April.

AST

In addition, Annual Surveillance Tests (AST) should be conducted in accordance with EN 14181; these are a series of measurements that need to be conducted with independent measurement equipment in parallel to the existing AMS. The AST tests are performed annually. In the years in which a full QAL 2 test is performed (at least every 3 years), an additional AST test is not necessary.

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[37] TÜV Immissionsschutz und Energiesysteme GmbH, Köln TÜV Rheinland Group Report No. 936/21203173/A vom 13. Juli 2005

[38] TÜV Rheinland Sicherheit und Umweltschutz GmbH, Köln (report number 936/808 005/C vom 18. Februar 2000) and TÜV Immissionsschutz und Energiesysteme GmbH, Köln (report number 936/rö vom 15. Oktober 2003)

QAL3

QAL3 describes the ongoing quality assurance and maintenance procedures and documentation for the AMS conducted by the plant operator. This documentation should demonstrate that the AMS are in control during their operation so that they continue to function within the required specifications for uncertainty.

This is achieved by conducting periodic zero and span checks on the AMS. Zero and span adjustments or maintenance of the AMS may be necessary depending on the results of the evaluation. In essence, YARA staff performs QAL3 procedures through the established calibration procedures described below.

AMS calibration and QA/QC procedures

The monitoring equipment used to derive the N_2O emissions data for this project will be made part of the ISO 9001 procedures.

N_2O-Analyser Zero Calibration

Conditioned ambient air is used as reference gas for zero calibration. The zero calibration is conducted automatically every 24 hours. Manual calibrations are done at least once per month (the calibration frequency might be adjusted if necessary).

N_2O-Analyser Span calibration

Manual span calibrations are done with certified calibration gas at least once per month (the calibration frequency might be adjusted if necessary).

The calibration results and subsequent actions are all documented as part of the QAL3 documentation. In addition, the analyser room and equipment is visually inspected at least once a week and the results are documented in analyser-specific log books.

Flow meter calibration procedures

The flow meters themselves do not need to be calibrated since they are physical devices that will not have drift. Therefore, it is sufficient to regularly inspect the physical condition of the flow meters. They are checked regularly for the following: Visual check; electric check; cleaning of probes if necessary. In addition, the flow meters are checked during the QAL2 and AST tests by an independent laboratory by comparison with a Standard Reference Method (SRM).

B.8. Date of finalisation of application of the reference scenario and monitoring methodology and the name of the person/entity responsable

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N_2O concentration in the stacks has been measured since 1st January 2002 showing an average concentration equal to approximately 5.7kgN_2O/tHNO_3 before the installation of the N_2O abatement catalyst in mid 2002.

This value of 5.7kgN_2O/tHNO_3 has been used as a basis for calculating the expected project emissions factor that will result from the installation of the full batches of catalyst for the project activity, assuming an abatement efficiency of about 95%.

However, due to the application of a benchmark emissions factor for calculating the emissions reductions achieved by the project, there is no measured baseline to be established. The MEEDDM established fixed benchmark values (as specified in section A.5) on the 10th April 2009.

Mrs Rebecca Cardani-Strange from N.serve Environmental Services GmbH and Mr Philippe Michiels from Yara Pardies are responsible for the application of the reference scenario and monitoring methodology.

SECTION C. Duration of the project activity/crediting period

C.1. Duration of the project activity

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C.1.1. Date of commencement of the project activity

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Under the Kyoto Protocol JI mechanism, Project Participants can claim Emission Reduction Units (ERUs) only for physical GHG reductions achieved after 1st January 2008.

In principle, ERUs can only be awarded for N_2O emissions reductions achieved after the underlying project activity has been approved by the authority responsible for this final approval in accordance with French Projet Domestique regulations. As stated in section A.5 above, the French MEEDDM finally approved the project-specific methodology in July and so the project participants decided to install the N_2O abatement system in August 2009. If the plant had taken the decision to wait until the receipt of a final Letter of Approval, the project start may well have been delayed until the following plant shutdown in summer 2010. The French Projet Domestique rules state that a project shall only be eligible to receive ERUs for emissions reductions achieved following either a) the receipt of the final official Letter of Approval (LoA) from the MEEDDM or b) from the date two months after submission of the full project documentation and request for LoA to the MEEDDM, whichever is the earlier. The full project documentation (which includes the Determination Report) was submitted to the MEEDDM on the 4th January 2010 and so the crediting period should theoretically have commenced on the 4th March. However, since some amendments were subsequently made to the PDD and the Determination report, the whole approval process must be repeated. The final approval is therefore now expected by the end of July 2010 and the official date of project commencement is estimated to be 1st August 2010.

C.1.2. Anticipated duration of the project's operational life

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The anticipated duration of the project's operational life is 2 years and 5 months (until the end of December 2012), since it is expected that N_2O emissions from HNO_3 plants will be covered by the EU ETS from 2013 onwards and that the project will no longer be viable[39]. If this is not the case, and N_2O is not otherwise regulated in a way that prohibits the continuation of the project, the project's operational life will be 10 years, in accordance with the crediting period specified in C.2.2 below.

C.2. Crediting Period

C.2.1. Date of commencement of the crediting period

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[39] See footnote 27

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As stated above in section C.1.2, and in accordance with the methodology "Catalytic reduction of N_2O at nitric acid plants", the project shall be eligible to receive ERUs for all emissions reductions physically achieved following either: a) the receipt of the final official Letter of Approval (LoA) from the MEEDDM or b) from the date two months after submission of the full project documentation and request for LoA to the MEEDDM, whichever is the earlier. The full project documentation (which includes the Determination Report) was submitted to the MEEDDM on the 4th January 2010 and so the crediting period should theoretically have commenced on the 4th March. However, since some amendments were subsequently made to the PDD and the Determination report, the whole approval process must apparently be repeated. The final approval is therefore now expected by the end of July 2010 and the official date of project commencement is estimated to be 1st August 2010.

C.2.2. Duration of the crediting period

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The Project Participants herewith apply for a crediting period of 10 years. The Projet Domestique will be terminated earlier if there is a legal requirement to do so. All laws relevant for this project[40] will be complied with at all times during the chosen crediting period.

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[40] See section B.1 above for more detailed information.

SECTION D. Environmental Impacts

D.1. Documentation concerning Environmental Impact Assessment

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The project will reduce gaseous emissions of nitrous oxide (N_2O) from the plant tail gas and will therefore contribute to international efforts to reduce greenhouse gas emissions. The project will have no negative effects on local air quality.

The project will have no impact on water pollution. No additional water is required for the project activity’s implementation or operation. Therefore, there is no impact on the sustainable use of water.

Also, the project does not impact on the community’s access to other natural resources as it will not require any additional resources. Also, there is no impact on the efficiency of resource utilization.

The YARA group is in the process of developing a recycling procedure for its spent catalyst. For the time being, until this procedure is finalised, the used catalyst will be kept on site at YARA Pardies and will be sent for recycling as soon as this is possible. There are no other positive or negative impacts on the environment.

D.2. If the impact on the environment is considered significant by the project participants or by the French administration, please provide conclusions and all reference documentation from the Environmental Impact Assessment in accordance with the procedures required by the French administration

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not applicable

SECTION E. Local Stakeholder Consultation

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As the JI project does not have any relevance for local air, water or soil emissions, a local stakeholder consultation is not considered necessary.

However, in accordance with article number R 512-33 of the 'code de l'environnement'[41], there is a necessity for the project participants to inform the local authorities of the changes made at the plant as a result of the project. In this case, Pardies has been in close contact with both the local préfet and the DRIRE regarding the installation of a catalyst to reduce N2O emissions at their plant for the past several months and so the local authorities are very aware of the position with regard to the project activity.

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[41] http://droit-finances.commentcamarche.net/legifrance/22-code-de-l-environnement/65902/article-r512-33

ANNEXES

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Annex 2. Information concerning the application of the reference scenario methodology

Not applicable in the case of the application of a benchmark reference value for determining the project emissions reductions.

Annex 3. Information concerning the monitoring plan

Background on EN14181

The objective is to achieve the highest level of accuracy practically possible when conducting measurements and transparency in the evaluation process.

While EN14181 provides the most advanced procedures, its practical application is currently limited for the following reasons:

- Specific procedures for N_2O are not yet defined in EN14181;
- Only very limited experience exists with monitoring systems for N_2O emissions;
- In the context of conducting some of the calculations and tests of EN14181, no applicable N_2O-specific regulations exist in the EU (or elsewhere); and

Therefore, it is currently not possible to fully comply with EN14181 to the letter, neither in the EU, nor in a non-Annex 1 country to the Kyoto Protocol.

Despite all this, EN14181 provides very useful guidance in conducting a logical, step-by-step approach to selecting, installing, adjusting and operating the N_2O AMS for CDM and JI projects.

The monitoring procedures developed for this project aim at providing workable and practice-orientated solutions that take into account the specific situation at each nitric acid plant. Wherever possible, EN14181 is applied as guidance for the development and implementation of the monitoring procedures for this Projet Domestique in order to achieve highest possible measurement accuracy and to implement a quality control system that assures transparency and credibility.

Scope of EN 14181

This European Standard specifies procedures for establishing quality assurance levels (QAL) for automated measuring systems (AMS) installed at industrial plants for the determination of the flue gas components and other flue gas parameters.

This standard is designed to be used after the AMS has been accepted according to the procedures specified in EN ISO 14956 (QAL1).

EN14181 specifies:

- a procedure (QAL2) to calibrate the AMS and determine the variability of the measured values obtained, so as to demonstrate the suitability of the AMS for its application following its installation;
- a procedure (QAL3) to maintain and demonstrate the required quality of the measurement results during the normal operation of an AMS, by checking that the zero and span characteristics are consistent with those determined during the QAL1;
- a procedure for the annual surveillance tests (AST) of the AMS in order to evaluate (i) that it functions correctly and its performance remains valid and (ii) that its calibration function and variability remain as previously determined.

This standard is restricted to quality assurance (QA) of the AMS, and does not include the QA of the data collection and recording system of the plant.

For a full description of the AMS to be installed at YARA Pardies nitric acid plant, as well as details on the quality assurance and control procedures to be undertaken, see section B.7.2 above.