Project design document form for CDM project activities

(Version 08.0)

Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for CDM project activities" at the end of this form.

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Fertinal Nitrous Oxide Abatement Project
Version number of the PDD	1.3
Completion date of the PDD	23/08/2016
Project participant(s)	Impulso Ecologico y Desarrollo Sustentable, SA de CV Nordic Environment Finance Corporation
Host Party	Mexico
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	ACM0019: "N_2O abatement from nitric acid production"(Version 02.0)
Sectoral scope(s) linked to the applied methodology(ies)	Scope 5
Estimated amount of annual average GHG emission reductions	250,479 t CO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The purpose of the proposed project activity is to reduce the current emissions of nitrous oxide (N_2O) from the production of nitric acid at the Fertinal Complex in Lázaro Cárdenas, Michoacán, Mexico.

To produce nitric acid, ammonia (NH_3) is reacted with air over a precious metal (normally a platinum rhodium (Pt-Rh) alloy) catalyst gauze pack in the ammonia oxidation reactor of nitric acid plants. A maximum 98% (typically 92-96%) of the ammonia fed is converted to nitric oxide (NO). Nitrous oxide is an undesired by-product gas from the manufacture of nitric acid. Nitrous oxide is formed during the catalytic oxidation of ammonia. The remainder of the ammonia participates in undesirable side reactions that lead to the production of nitrous oxide, among other compounds.

Waste N_2O from nitric acid production is typically released into the atmosphere, as it does not have any economic value or toxicity at typical emission levels. N_2O is an important greenhouse gas which has a high global warming potential (GWP) of 298.

The nitric acid plant at Lázaro Cárdenas is considered, of its type, one of the biggest in Latin America.

The Lázaro Cárdenas fertilizer's complex started operations in 1987 as FERTIMEX, a national company, acquiring the name of FERTINAL in 1992 upon privatization. Between 2001 and 2006 the fertilizer's complex was idled due to devastating damages perpetrated by hurricane Juliette over the phosphate rock mine owned by the group on the Baja California peninsula, which disrupted supply of the main raw material for the complex. A long litigation process over the insurance policy (finally settled on May 2007) allowed reconstruction of the mine and the restoring of operations at the fertilizer's complex.

The project activity involves the installation of a secondary catalyst to abate N_2O inside the reactor once it is formed. The project transferred a new, environmentally clean technology to Mexico that was not even common industrial practice in Annex 1 countries. Also, the project led to an enhancement of skills as employees were trained to operate both the N_2O abatement catalyst and the automated monitoring system.

The baseline scenario is determined to be the release of N_2O emissions to the atmosphere at the currently measured rate, in the absence of regulations to restrict N_2O emissions.

Additional N_2O monitoring and recording facilities were installed to measure the amount of N_2O emitted by the project activity.

The project activity contributes to the sustainable development of the country through industrial technology transfer (catalyst technology from a developed country to Mexico). The project activity reduces N_2O emissions and neither increases nor decreases direct emissions of other air pollutants.

The project has not impact on the local communities or access of services in the area. The project activity does not cause job losses at Fertinal nitric acid plant. The Fertinal Nitrous Oxide Abatement Project has the potential to be replicated by other nitric acid plants in the country and in other developing countries.

The estimated annual average of GHG emission reductions for the crediting period is 250,479 t CO_2e. The total amount of GHG emissions reductions to be obtained during the crediting period is 1,753,350 t CO_2e.

The proposed project activity is not a CPA that has been excluded from a registered PoA as result of erroneous inclusion of CPAs.

A.2. Location of project activity

A.2.1. Host Party

>>
Mexico

A.2.2. Region/State/Province etc.

>>
Michoacán

A.2.3. City/Town/Community etc.

>>

Lázaro Cárdenas

A.2.4. Physical/Geographical location

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The project is located at Fertinal facilities, in the Middle Island without number, Lázaro Cárdenas, state of Michoacán, México, (17º 55’ North and 102° 12' West), with an altitude above sea level of 1.5 to 3.5 meters; and land area of 1,540,556.02 m^2.

Figure 1: Fertinal nitric acid plant geographical location

A.3. Technologies and/or measures

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The Ostwald process

Nowadays, all commercial nitric acid is produced by the oxidation of ammonia and subsequent reaction of the oxidation products with water, through the Ostwald process.
The basic Ostwald process involves 3 chemical steps:

A) Catalytic oxidation of ammonia with atmospheric oxygen, to yield nitrogen monoxide (i.e, nitric oxide)

(1) $4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$

B) Oxidation of the nitrogen monoxide to nitrogen dioxide, i.e., dinitrogen tetroxide

(2) $2\ NO + O_2 \rightarrow 2\ NO_2 \rightarrow N_2O_4$

C) Absorption of the nitrogen dioxide in water to yield nitric acid

(3) $3\ NO_2 + H_2O \rightarrow 2\ HNO_3 + NO$

Reaction 1 is favored by lower pressure and higher temperature. However, at excessively high temperature, secondary reactions take place that lower the yield (affecting nitric acid production). Hence, an optimal temperature is found between 850 and 950º C, depending on other process conditions and catalyst chemical composition (Figure 2)[1]. Reactions 2 and 3 are favored by higher pressure and lower temperatures.

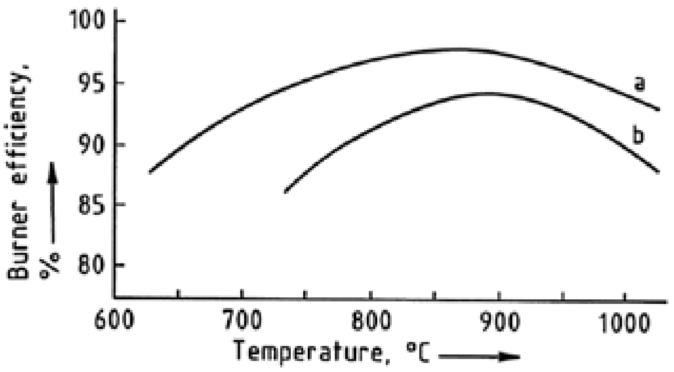

Figure 2. Conversion of ammonia to nitrogen monoxide on platinum gauze as a function of temperature (a) 100 kPa; (b) 400 kPa [1]

The way in which these three steps are implemented characterizes the various nitric acid processes found throughout the industry. In mono pressure or single pressure processes ammonia combustion and nitrogen oxide absorption take place at the same working pressure. In dual pressure or split pressure plants the absorption pressure is higher than the combustion pressure.

Nitrous oxide formation

Nitrous oxide is formed during the catalytic oxidation of ammonia. Over a suitable catalyst, a maximum 98% (typically 92-96%) of the ammonia fed is converted to nitric oxide (NO) according to Reaction (1) above. The remainder participates in undesirable side reactions that lead to nitrous oxide (N_2O), among other compounds.
These are the side reactions occurring during oxidation of ammonia:

(4) $4\ NH_3 + 4\ O_2 \rightarrow 2\ N_2O + 6\ H_2O$ (nitrous oxide formation)

(5) $4\ NH_3 + 3\ O_2 \rightarrow 2\ N_2 + 6\ H_2O$

[1] Thieman et al., “Nitric Acid, Nitrous Acid, and Nitrogen Oxides”, *Ullmann’s Encyclopedia of Industrial Chemistry 6th Edition,* Wiley-VCH Verlag GmbH & Co. KGaA. All rights reserved.

(6) $2\ NO \rightarrow N_2 + O_2$

(7) $4\ NH_3 + 6\ NO \rightarrow 5\ N_2 + 6\ H_2O$

N_2O abatement technology of the project activity

The project activity consists in the elimination of the N_2O once it is formed by installing a secondary catalyst (not previously installed) inside the ammonia oxidation burner and below the ammonia oxidation gauzes. This kind of abatement is known as secondary abatement.

The sole purpose of the installation of the secondary catalyst is to destroy the N_2O.

The secondary abatement has the following advantages:

- The catalyst does not consume electricity, steam, fuels or reducing agents (all sources of leakage) to eliminate N_2O emissions; thus, operating costs are negligible and the overall energy balance of the plant is not affected.
- Installation is extremely simple and does not require any new process unit or re-design of existing ones (only in a few cases, the reactor basket needs some minor modifications to accommodate the new catalyst).
- Installation is also very fast, so it is done simultaneously with a primary gauze changeover; thus, the plant has no loss in production due to incremental downtime.

Fertinal installed a secondary catalyst system provided by BASF.

BASF has developed a solution for a “secondary” catalyst, which sole purpose is to decompose N_2Owithout affecting nitric acid production. Typically the catalyst has a very high activity for N_2Odecomposition (the expected removal efficiency is 85-90%). Beyond high abatement of N_2O, some other advantages of the use of secondary catalyst are: proven performance, no measurable effect on ammonia to nitric oxide yield, and its implementation does not lead to increased NO_X emissions.

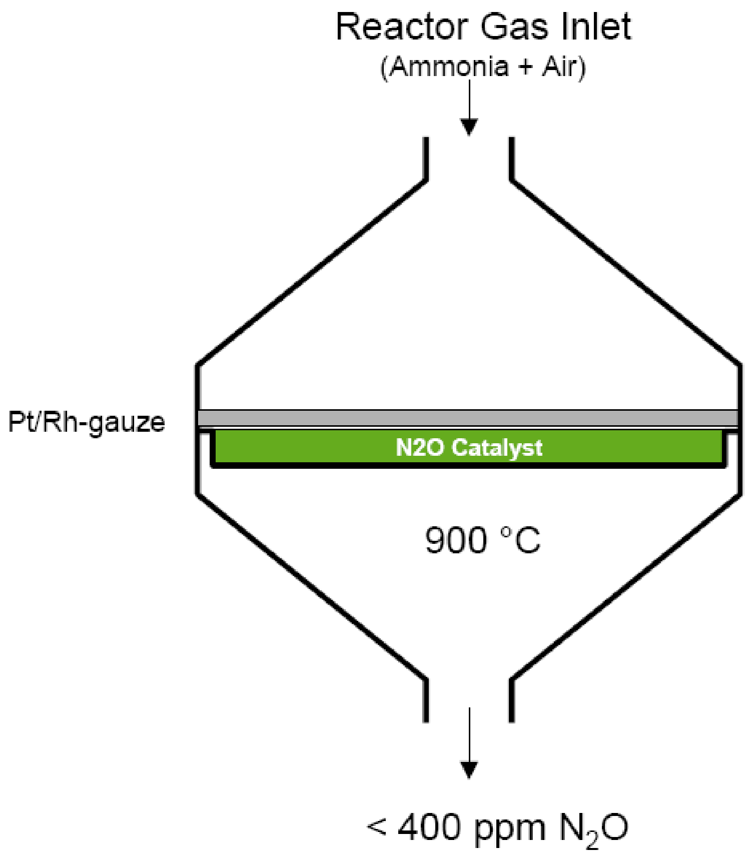

Figure 3.The diagram above depicts a typical installation of a DeN_2O Secondary Catalyst.

The chosen N_2O abatement catalyst vendor takes back the catalyst at the end of its useful life and refine, recycle or dispose of it according to the prevailing standards and hence fulfill sustainability standards. In the future, Fertinal will re-evaluate performance and cost advantages of the BASF system vs those available in the market, and may eventually switch to another secondary catalyst supplier, in order to assure the best available technology is utilized for the project. Nevertheless, this decision will not affect in any way the project activity as described in this PDD.

AMS (Automated Monitoring System)

According the methodology, the gas flow and the N_2O concentration in the stack have to be monitored in a quasi-continuous basis through an Automated Measuring System.
For that purpose, Fertinal installed a continuous gas analyzer from the supplier ABB; model AO2000, while the specific module to measure N_2O is a non-dispersive infrared analyzer called URAS 26. The instrument descriptions according to the manufacturer are given below:

Infrared Analyzer Module Uras26

Measurement Principle

Non-dispersive infrared absorption in the λ = 2.5–8 µm wavelength range

Photometer to measure from 1 to 4 components with 1 or 2 beam paths and 1 or 2 receivers in each beam path

Sample Components and Smallest Measurement Ranges

The Uras26 analyzer module has one physical measurement range per sample component. As an option, smaller measurement ranges can be electronically derived from the physical measurement range. The smallest range is measurement range 1.

The smallest measurement ranges shown in the following table are based on the first sample component in beam path 1.

Sample Component	Class 1 Range	Class 2 Range	Class 2 Range with Calibration Cell	Gas Group [1]
CO	0– 50 ppm	0– 10 ppm	0– 50 ppm [2]	A
CO_2	0– 50 ppm	0– 5 ppm	0– 25 ppm [2]	A
NO	0– 75 ppm	0– 75 ppm	0– 75 ppm [2]	A
SO_2	0– 100 ppm	0– 25 ppm	0– 25 ppm [2]	A
N_2O	0– 50 ppm	0– 20 ppm	0– 50 ppm [2]	A
CH_4	0– 100 ppm	0– 50 ppm	0– 50 ppm [2]	A
NH_3	0– 500 ppm	0– 30 ppm	–	B
C_2H_2	0– 200 ppm	0– 100 ppm	0– 100 ppm	B
C_2H_4	0– 500 ppm	0– 300 ppm	0– 300 ppm	B
C_2H_6	0– 100 ppm	0– 50 ppm	0– 50 ppm [2]	B
C_3H_6	0– 250 ppm	0– 100 ppm	0– 100 ppm [2]	B
C_3H_8	0– 100 ppm	0– 50 ppm	0– 50 ppm [2]	B
C_4H_{10}	0– 100 ppm	0– 50 ppm	0– 50 ppm [2]	B
C_6H_{14}	0– 500 ppm	0– 100 ppm	0– 100 ppm [2]	B
R 134a	0– 100 ppm	0– 50 ppm	0– 50 ppm [2]	B
SF_6	0–2000 ppm	0– 1900 ppm	0–2000 ppm	B
H_2O	0– 1000 ppm	0– 500 ppm	0– 500 ppm	C

1) See price information
2) Measurement range 1 the smallest is shown. The largest measurement range should be at least four times larger.

Other sample components on request.

The following data apply to measurement range 1 in a delivered analyzer module.

Sensitivity Drift
≤ 1 % of measured value per week

Output Fluctuation (2 σ)
≤ 0.2 % of span at electronic T90 time = 5 sec (Class 1) or = 15 sec (Class 2)

Detection Limit (4 σ)
≤ 0.4 % of span at electronic T90 time = 5 sec (Class 1) or = 15 sec (Class 2)

Measurement Ranges

Quantity
1 to 4 ranges per sample component

Largest Measurement Range
0 to 100 Vol.-% or 0 Vol.-% to saturation or 0 Vol.-% to LEL
Measurement ranges within ignition limits cannot be provided.

Measurement Range Ratio
≤ 1:20

Measurement Ranges with Suppressed Zero-Point
Electronic zero-point suppression or differential measurement based on a base level > 0 with flowing reference gas, max. suppression ratio of 1:10

Measurement Range Switching
Manual; available external control or automatic

Limit Value Monitoring
Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

Calibration

Zero-Point Calibration
With inert gas, e.g. N_2, or with ambient air that is free of the sample component.

End-Point Calibration
With gas-filled calibration cells (optional) or with test gas mixtures. It is recommended to verify the calibration cell set values once a year.
During calibration of a multi-component analyzer, possible cross-sensitivity and/or carrier gas corrections by internal or external measurement components are switched off.
Therefore, corrected measurement components should be calibrated only using a test gas consisting of the measurement component and an inert gas like N_2.

Influence Effects

Stability

Linearity Deviation
≤ 1 % of span
Option: Linearization for automobile exhaust gas measurement according to EPA specifications

Repeatability
≤ 0.5 % of span

Zero Drift
≤ 1 % of span per week;
for ranges smaller than Class 1 to Class 2:
≤ 3 % of span per week

Influence Effects

Flow Effect
Flow rate in the 20–100 l/h range: within determination limits

Associated Gas Effect/Cross Sensitivity
The knowledge of the sample gas composition is necessary for the analyzer configuration.
Selectivity measures to reduce associated gas effect (optional): Incorporation of interference filters, filter vessels or internal electronic cross-sensitivity correction or carrier gas correction for a sample component by other sample components measured with the Uras26.

Infrared Analyzer Module Uras26

Temperature Effect
Ambient temperature in permissible range
- At zero-point: ≤ 1 % of span per 10 °C;
  for ranges smaller than Class 1 to Class 2:
  ≤ 2 % of span per 10 °C
- On sensitivity with temperature compensation:
  ≤ 3 % of measured value per 10 °C
- On sensitivity with thermostat effect at 55 °C (optional):
  ≤ 1 % of measured value per 10 °C

Air Pressure Effect
- At zero-point: No effect
- On sensitivity with pressure correction by means of integral pressure sensor: ≤ 0.2 % of measured value per 1 % barometric pressure change

The pressure sensor is located in the sample gas path if hoses are used as the internal gas lines.
If tubing is used for internal gas lines the pressure sensor is routed to the outside via a hose.
Pressure sensor working range: p_{abs} = 600–1250 hPa

Power Supply Effect
24 VDC ± 5 %: ≤ 0.2 % of span

Dynamic Response

Warm-Up Time
Approx. 30 minutes without thermostat; approx. 2 hours with thermostat

90% Response Time
T_{90} = 2.5 sec for measurement cell length = 200 mm and sample gas flow = 60 l/h without signal damping (low pass filter). Low-pass time constant adjustable from 0 to 60 sec

Materials in Contact with the Sample Medium

Analyzer (Sample Cells)
Tubing: Aluminum or gold-plated aluminum;
Window: CaF_2, Option: BaF_2;
Connectors: Rust- and acid-resistant steel 1.4571

Gas Lines and Connectors
FPM hoses and PTFE tubing with stainless steel connectors;
Option: Rust- and acid-resistant steel tubes 1.4571

Gas Connections

Layout and Design
Gas ports on back (19-inch rack housing) or bottom (wall-mount housing) of the analyzer module with 1/8 NPT internal threads for commercially available adapters, e.g. Swagelok®.
See page 34 for connection drawing.

Electrical Connections

System Bus
3-pin female plug

External 24-VDC Power Supply
4-pin male plug

Gas Inlet Conditions

Temperature
The sample gas dew point should be at least 5 °C below the ambient temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Inlet Pressure
p_e = 2–500 hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure
Atmospheric pressure

Flow Rate
20–100 l/h

Corrosive Gases
Highly corrosive associated gas components, e.g. chlorine (Cl_2) and hydrogen chloride (HCl), as well as gases or aerosols containing chlorine must be cooled or undergo prior absorption. Provide for housing purge.

Flammable Gases
The analyzer module is suitable for measuring flammable gases and vapors under atmospheric conditions (p_{abs} ≤ 1.1 bar, oxygen content ≤ 21 Vol.-%). Temperature Class: T4. The sample gas must not be explosive under normal conditions. If the sample gas is explosive in the event of a sample gas supply failure, then only seldom and briefly (in accordance with Zone 2). Pressure in the sample gas path in normal operation p_e ≤ 100 hPa; in case of a sample gas supply failure the pressure must not exceed the maximum value p_e = 500 hPa. The version with gas paths designed as stainless steel tubes should be selected and housing purge with N_2 should be provided when measuring flammable gases and vapors. Before using the analyzer module the corrosion resistance against the specific sample gas must be checked.

Purge Gas
The purge gas should not contain any sample gas components.

Power Supply

Input Voltage, Power Consumption
24 VDC ± 5 %, max. 95 W

Installation Site Requirements

Vibration
max. ±0.04 mm at 5 to 55 Hz, 0.5 g at 55 to 150 Hz
Slight transient effect on sample value in the region of the beam modulation frequency

Ambient Temperature
Operation: +5 to +40/45 °C when installed in housing with/without electronics module;
Storage and transport: –25 to +65 °C

Figure 4: Fertinal N_2O analyzer specifications

For stack flow measurement, Fertinal plant selected as primary meter an Annubar principle (multiple pressure differential) unit, model 485 Annubar primary manufactured by Rosemount Inc. (USA).

Table below summarize the specifications of the Annubar unit:

Rosemount 485 *Annubar* Primary

SPECIFICATIONS

Performance

Performance Statement Assumptions
Measured pipe I.D.

Discharge Coefficient Factor
±0.75% of flow rate

Repeatability
±0.1%

Line Sizes
- Sensor Size 1: 2-in. to 8-in. (50 to 200 mm)
- Sensor Size 2: 6-in. to 96-in. (150 to 2400 mm)
- Sensor Size 3: 12-in. to 96-in. (300 to 2400 mm)

NOTE
Some mounting types are not available in larger line sizes.

TABLE 26. Reynolds Number and Probe Width

Sensor Size	Minimum Rod Reynolds Number (R_d)	Probe Width ($_d$) (inches)
1	6500	0.590-in. (14.99 mm)
2	12500	1.060-in. (26.92 mm)
3	25000	1.935-in. (49.15 mm)

Functional

Service
- Liquid
- Gas
- Steam

Process Temperature Limits
Direct Mount Electronics
- 500 °F (260 °C)
- 750 °F (400 °C) when used with a direct mount, high temperature 5-valve manifold (Electronics Connection Platform code 6)

Remote Mount Electronics
- 1250 °F (677 °C) – *Hastelloy* Sensor Material
- 850 °F (454 °C) – Stainless Steel Sensor Material

Pressure and Temperature Limits[1]
Direct Mount Electronics
- Up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C))
- Integral temperature measurement is not available with Flanged mounting type greater than class 600

Remote Mount Electronics
- Up to 2500# ANSI (6000 psig at 100 °F (416 bar at 38 °C)).

Figure 5: Fertinal flow meter specifications

Figure 6 shows the flow diagram of the nitric acid plant of Fertinal, where the project takes place including the locations of the secondary catalyst and the installed AMS.

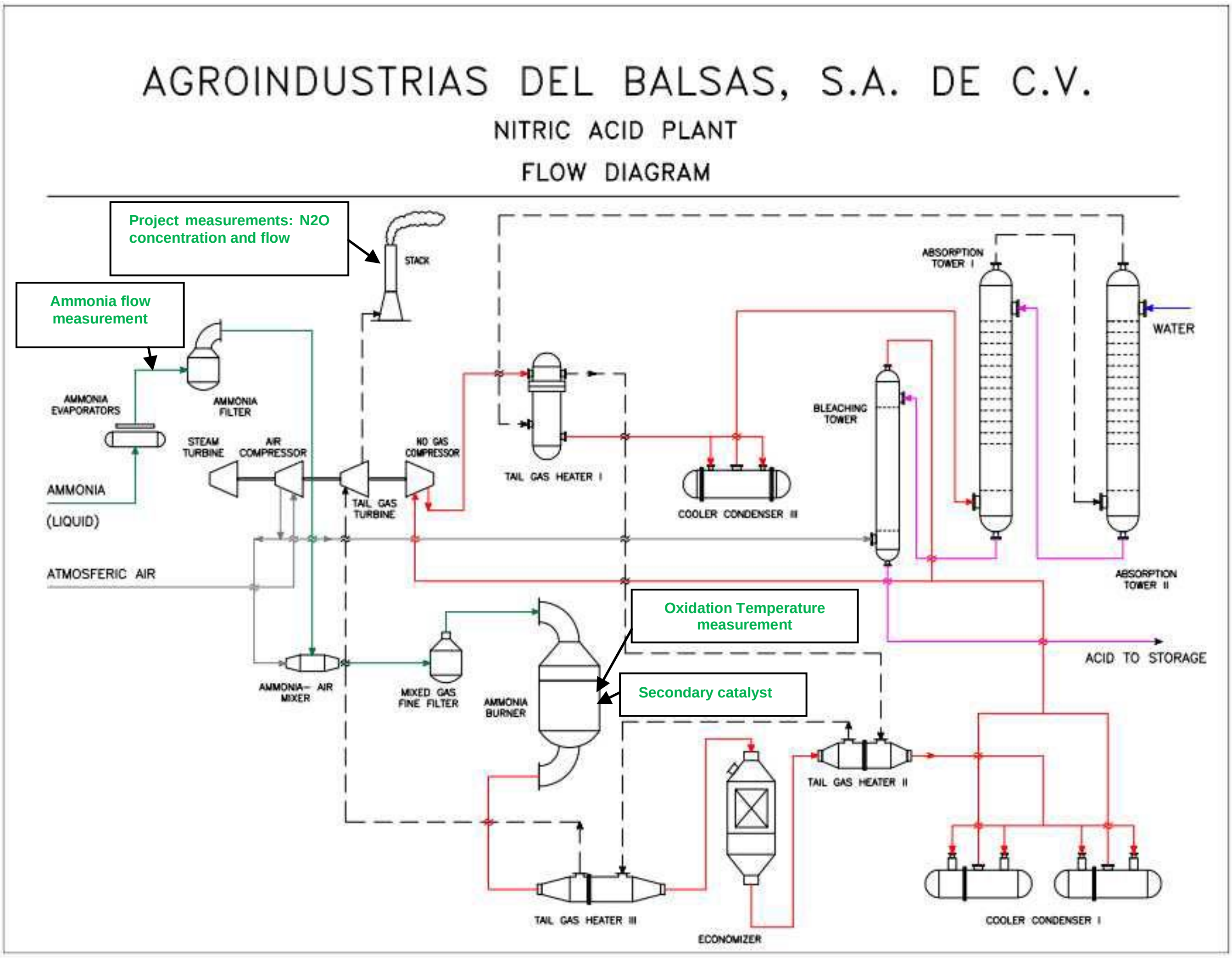

Figure 6: Fertinal nitric acid plant flow sheet

Fertinal employees were trained before the beginning of the project on how supervise and effectively operate the secondary catalyst technology and the AMS installed to monitor the N_2O emissions. Also, they received instructions for collecting the data measured by the AMS, to allow the successful completion of each verification procedure.

A.4. Parties and project participants

Party involved (host) indicates host Party	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Mexico (host)	Impulso Ecológico y Desarrollo Sustentable, SA de CV Private entity	No
Finland	Nordic Environment Finance Corporation Private entity	No

A.5. Public funding of project activity

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No public funds were available for the financing of the project activity. Therefore, Fertinal financed the project activity on the expectation of its approval

SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology and standardized baseline

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The selected methodology is ACM0019: "Large-scale Consolidated Methodology: N_2O abatement from nitric acid production" (Version 02.0)

The following tools are also considered by the selected methodology:

"Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 3.0)
"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 2)

B.2. Applicability of methodology and standardized baseline

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The project consists of the installation of a secondary catalyst inside the ammonia burner of the nitric acid plant; with the purpose of destroy the N_2O formed during the oxidation of ammonia.
The project complies with the applicability conditions given by the chosen methodology, as follows:

- The nitric acid plant at Lázaro Cárdenas industrial unit started operations in 1987. The project activity was registered by the UNFCCC on October 17th, 2009 and the first campaign operated with the secondary catalyst installed, started on March 12th, 2010. Therefore, the secondary catalyst was installed as consequence of project implementation.
- Fertinal nitric acid plant has installed the appropriate AMS according to the methodology requirements. Moreover, employees have been operating the technology during the first crediting period and are trained to take care of the correct maintenance of it. Therefore, the continuous real time measuring of N_2O concentration and gas volume flow at the stack until the end of the project activity, are assured.
- At Mexico there is no law or regulation that would force Fertinal to abate the N_2O emissions.

The project activity also complies with the applicability condition of the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 3.0), since the flow and composition of the exhaust gas are measured for the determination of baseline and project emissions.

The "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" (Version 2) is not applicable to the proposed project activity since it does not apply tertiary abatement technology.

B.3. Project boundary

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	NH_3 oxidation at the primary catalyst gauze	CO_2	No	The project activity has no influence on these types of emissions, if present
		CH_4	No	
		N_2O	Yes	Included, main emission source.
Project scenario	NH_3 oxidation at the primary catalyst gauze	CO_2	No	The project activity has no influence on these types of emissions, if present
		CH_4	No	
		N_2O	Yes	Included, main emission source. The amount of N_2O which was not destroyed by the project activity.

The following diagram shows the project boundary of the project activity.

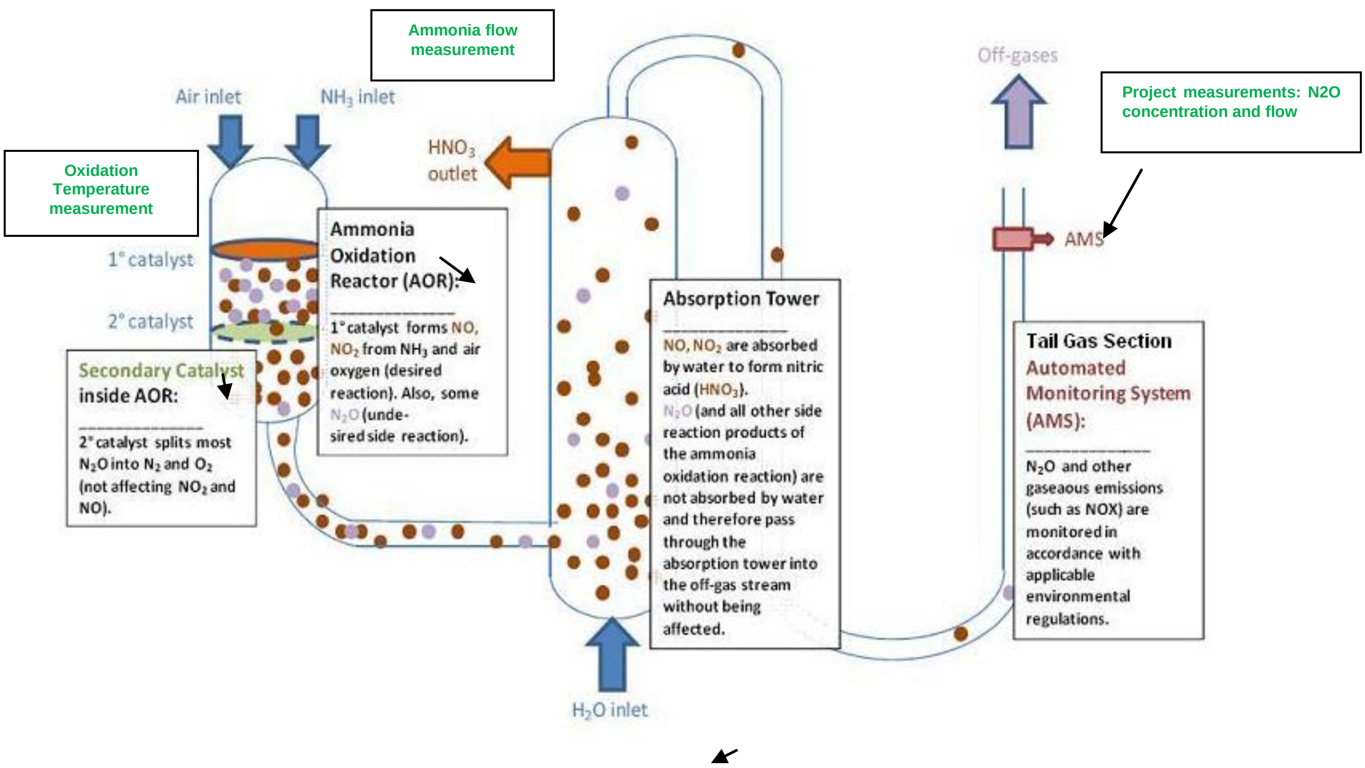

Figure 7: Project boundary

The project boundary encompasses the physical, geographical site of Fertinal and equipment for the complete nitric acid production process from the inlet of the ammonia burner to the stack. The only GHG emission relevant to the project activity is N_2O contained in the waste stream exiting the stack.

The abatement of N_2O is the only GHG emission under the control of the project participant.

The secondary catalyst utilizes the heat liberated by the highly exothermal oxidation reaction (that occurs on the precious metal gauzes of the primary catalyst) to reach its effective operating temperature. Once the operating temperature is reached, no incremental energy is necessary to sustain the reaction.

The operating hours of the nitric acid plant are determined based on the present thresholds for oxidation temperature and ammonia flow to the reactor.

B.4. Establishment and description of baseline scenario

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In Mexico there aren't any regulation requiring the abatement of N_2O emissions and Fertinal has no economic incentives to take any N_2O abatement measures because this entails capital and operating costs without financial benefits. Therefore, the CDM project activity is considered additional and the baseline scenario is that the N_2O is emitted to the atmosphere with no N_2O abatement measure being implemented.

Fertinal had registered the proposed project activity under the methodology AM0034 in 2009; and the project activity has been financed by the sale of CERs.

B.5. Demonstration of additionality

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The table below is only applicable if the proposed project activity is a type of project activity which is deemed automatically additional, as defined by the applied approved methodology or standardized baseline.

Specify the methodology or standardized baseline that establish automatic additionality for the proposed project activity (including the version number and the specific paragraph, if applicable).	**ACM0019 ver 02.0** In the absence of regulations requiring the abatement of N_2O emissions, the operator of the nitric acid plant has no economic incentives to take any N_2O abatement measures because this entails capital and operating costs but no financial benefits. Therefore, the CDM project activity is considered additional and the baseline scenario is that the N_2O is emitted to the atmosphere with no N_2O abatement measure being implemented.
Describe how the proposed project activity meets the criteria for automatic additionality in the relevant methodology or standardized baselines.	In Mexico there aren't any regulation requiring the abatement of N_2O emissions and Fertinal has no economic incentives to take any N_2O abatement measures because this entails capital and operating costs without financial benefits. Therefore, the CDM project activity is considered additional and the baseline scenario is that the N_2O is emitted to the atmosphere with no N_2O abatement measure being implemented. Fertinal had registered the proposed project activity under the methodology AM0034 in 2009; and the project activity has been financed by the sale of CERs.

B.6. Emission reductions

B.6.1. Explanation of methodological choices

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Calculation of baseline emissions

For calculating the baseline emissions *equation 1* of ACM0019 will be applied since it is applicable for projects that have used AM0034 during the first crediting period

$$BE_y = \left(min\{P_{production,y}\,; P_{product,max}\} \times EF_{existing,y} + max\{P_{production,y} - P_{product,max}; 0\} \times EF_{new,y}\right) \times \frac{(h_y - h_{r,y})}{h_y} \times GWP_{N2O} \times 10^{-3}$$

Equation (1)

Where

BE_y = Baseline emissions in year y (t CO_2e)
$P_{product,max}$ = Design capacity (t HNO_3)
$P_{production,y}$ = Production of nitric acid in year y (t HNO_3)
$EF_{existing,y}$ = N_2O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year y (kg N_2O/t HNO_3)
$EF_{new,y}$ = Baseline N_2O emission factor for nitric acid production in year y (kg N_2O/t HNO_3)
GWP_{N2O} = Global Warming Potential of N_2O valid for commitment period
h_y = Number of hours in year y during which the plant was in operation (h)
$h_{r,y}$ = Number of hours (h) in year y where: (a) for secondary N_2O abatement: the abatement system was not installed, underperforming or failed

$EF_{existing,y}$ is calculated using equation 2

$$EF_{existing,y} = \min(EF_{historical}\,; EF_{default,y})$$ Equation (2)

Where

$EF_{existing,y}$ = N_2O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year y (kg N_2O/t HNO_3)
$EF_{historical}$ = Historical baseline emission factor of the nitric acid plant (kg N_2O/t HNO_3)
$EF_{default,y}$ = Default emission factor according to the operating pressure of the ammonia burner in year y (kg N_2O/t HNO_3)

For Fertinal project $EF_{historical} < EF_{default,y}$ for the entire crediting period, then
$EF_{existing,y} = EF_{historical}$

<u>Calculation of $h_{r,y}$</u>

The abatement system is considered to be bypassed, not working, underperform or failed in the hour h in the year y if:
An abatement system is deemed to be bypassed, not working, underperform or failed in the hour h in year *y* if:

$$EF_{N2O,tail\ gas,h} > EF_{existing,y} \times P_{NA,h}$$ Equation (4)

Where:

$P_{NA,h}$= Nitric acid produced in the hour *h* (t HNO_3)
$EF_{existing,y}$= Default N_2O emission factor for nitric acid plants that have used AM0028 or AM0034 in the first crediting period in year *y* (kg N_2O/t HNO_3)
$EF_{N2O,tail\ gas,h}$= Mass flow of N_2O in the gaseous stream of the tail gas in the hour *h* (kg N_2O/h)

Calculation of project emissions

Project emissions are calculated using the following equations:

$$PE_y = PE_{N2O,y} + PE_{CO2,tertiary,y}$$ Equation (6)

Where:
PE_y= Project emissions in year *y* (t CO_2e)
$PE_{N2O,y}$= Project emissions of N_2O from the project plant in year *y* (t CO_2e)
$PE_{CO2,tertiary,y}$= Project emissions of CO_2 from the operation of the tertiary N_2O abatement facility in year *y* (t CO_2e)

$PE_{CO2,tertiary,y}$ is equal to 0 because Fertinal project does not include a tertiary abatement of N_2O.

Then,

$$PE_y = PE_{N2O,y}$$

Project emissions of N_2O from the plant are calculated using the following equation:

$$PE_{N2O,y} = \sum_1^{h_y - h_{r,y}} F_{N2O,tail\ gas,h} \times GWP_{N2O} \times 10^{-3}$$ Equation (7)

Where:
$PE_{N2O,y}$= Project emissions of N_2O from the project plant in year *y* (t CO_2e)
$F_{N2O,tail\ gas,h}$= Mass flow of N_2O in the gaseous stream of the tail gas in the hour *h* (kg N_2O/h)
GWP_{N2O}= Global Warming Potential of N_2O valid for commitment period
h_y= Number of hours in year y during which the plant was in operation (h)
$h_{r,y}$= Number of hours (h) in year y where: (a) for secondary N_2O abatement: the abatement system was not installed, underperforming or failed

<u>Determination of $F_{N2O,tail\ gas,h}$</u>

The parameter $F_{N2O,tail\ gas,h}$ is determined using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" (Version 3.0)
In the case of Fertinal project, the mass flow of N_2O is calculated following Option A of the tool, since the moisture content of the gas stream is less than 0.05 kg H_2O/m^3 dry gas.
Then, the equations 5 and 6 of the tool are applied as follows:

$$F_{N2O,tail\ gas,h} = V_{h,db} \times v_{N2O,h,db} \times \rho_{N2O,h}$$ Equation (8)

$$\rho_{N2O,h} = \frac{P_h \times MM_{N2O}}{R_u \times T_h}$$ Equation (9)

Where:
$F_{N2O,tail\ gas,h}$= Mass flow of N_2O in the gaseous stream in hour *h* (kg N_2O/h)

$V_{h,db}$ = Volumetric flow of the gaseous stream in the hour *h* on a dry basis (m^3 dry gas/h)
$v_{N2O,h,db}$=Volumetric fraction of N_2O in the gaseous stream in the hour *h* on a dry basis ($m^3 N_2O/m^3$ dry gas)
$\rho_{N2O,h}$= Density of N_2O in the gaseous stream in the hour *h* (kg N_2O/ m^3 N_2O)
P_h= Absolute pressure of the gaseous stream in the hour *h* (Pa)
MM_{N2O}= Molecular mass of N_2O (kg/kmol)
R_u= Universal ideal gas constant (Pa. m^3/kmol. K)
T_h= Temperature of the gaseous stream in the hour *h*(K)

N_2O concentration and volume flow at the stack gas are monitored continuously; every two second readings are recorded and stored electronically. Hourly averages of the two seconds readings are also recorded and stored, those values are used in the emission reduction calculation.
The monitoring system is maintained according to the European Norm 14181.
Monitored values of N_2O concentration and volume flow at the stack are corrected with the factors obtained from the calibration curves during the QAL2 test. The correction factors are applied to the hourly average values in the emission reduction calculation spread sheet.

If data for either the N_2O concentration or the volume flow of the tail gas are not available for more than 1/3 of any hour while the plant was in operation, the value for that hour shall be replaced with the maximum value of N_2O concentration or volume flow of the tail gas observed during the monitoring period. Values observed during five operating hours before and after a plant start-up and shut-down shall not be used for the determination of the maximum values.

Calculation of leakage

Any leakage emission sources are deemed to be negligible.

Calculation of emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \qquad \text{Equation (10)}$$

Where:
ER_y= Emission reductions in year *y* (t CO_2e)
BE_y= Baseline emissions in year *y* (t CO_2e)
PE_y= Project emissions in year *y* (t CO_2e)

B.6.2. Data and parameters fixed ex ante

Data / Parameter	**Operating pressure**
Unit	KPa
Description	Operating pressure of the ammonia burner
Source of data	Manufacturer specifications
Value(s) applied	364
Choice of data or Measurement methods and procedures	

Purpose of data	The parameter is used to determine whether the nitric acid plant operates at a low, medium or high pressure
Additional comment	NA

Data / Parameter	$EF_{historical}$
Unit	kg N_2O/t HNO_3
Description	Historical baseline emission factor of the nitric acid plant
Source of data	Fertinal baseline campaign spread sheet calculation.
Value(s) applied	5.71
Choice of data or Measurement methods and procedures	Calculated during the baseline campaign according to AM0034.
Purpose of data	Used in baseline emission calculation
Additional comment	This value will remain constant over the second and third crediting period

Data / Parameter	$EF_{default,y}$
Unit	kg N_2O/t HNO_3
Description	Default emission factor according to the operating pressure of the ammonia burner in year *y* (related to 100 per cent pure acid)
Source of data	This default N_2O baseline emission factor will vary every year. In the year 2013 the emission factors will be 5.5; 8.4; and 12.6 kg N_2O/t HNO_3 for low, medium and high pressure ammonia burners. For each subsequent year, the emission factors will decrease by 0.2 kg N_2O/t HNO_3 until they reach a value of 2.5 or 2.4. After reaching the values of 2.5 or 2.4 the emission factor will remain constant over time

<table>
<tr><td>Value(s) applied</td><td>

Year	Low pressure (0 – 200 kPa)	Medium pressure (200 – 600kPa)	High pressure (Over 600 kPa)
2013	5.5	8.4	12.6
2014	5.3	8.2	12.4
2015	5.1	8.0	12.2
2016	4.9	7.8	12
2017	4.7	7.6	11.8
2018	4.5	7.4	11.6
2019	4.3	7.2	11.4
2020	4.1	7	11.2
2021	3.9	6.8	11
2022	3.7	6.6	10.8
2023	3.5	6.4	10.6
2024	3.3	6.2	10.4
2025	3.1	6	10.2
2026	2.9	5.8	10
2027	2.7	5.6	9.8
2028	2.5	5.4	9.6
2029	2.5	5.2	9.4
2030	2.5	5.0	9.2

Since Fertinal Plant is a Medium pressure plant the values to be applied are :
2016: 7.8 ,
2017: 7.6
2018: 7.4
2019: 7.2
2020: 7
2021: 6.8
2022: 6.6
2023: 6.4</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>NA</td></tr>
<tr><td>Purpose of data</td><td>Used in baseline emission calculation</td></tr>
<tr><td>Additional comment</td><td>The decrease in the value for the baseline emission factor over time is to reflect the technological development.</td></tr>
</table>

Data / Parameter	$\mathbf{EF_{new,y}}$
Unit	kg N_2O/t HNO_3
Description	Baseline N_2O emission factor for nitric acid production in year y (related to 100 per cent pure acid)
Source of data	The baseline N_2O emission factor for nitric acid production will vary every year. In year 2005 the emission factor will be 5.1 and then it will decrease every year until it reaches a final value of 2.5 in the year 2020. The value of 2.5 will remain constant after 2020.

<table>
<tr><td>Value(s) applied</td><td>
<table>
<tr><th>Year</th><th>Emission factor ($kgN_2O/t\ HNO_3$)</th></tr>
<tr><td>2005</td><td>5.10</td></tr>
<tr><td>2006</td><td>4.90</td></tr>
<tr><td>2007</td><td>4.70</td></tr>
<tr><td>2008</td><td>4.60</td></tr>
<tr><td>2009</td><td>4.40</td></tr>
<tr><td>2010</td><td>4.20</td></tr>
<tr><td>2011</td><td>4.10</td></tr>
<tr><td>2012</td><td>3.90</td></tr>
<tr><td>2013</td><td>3.70</td></tr>
<tr><td>2014</td><td>3.50</td></tr>
<tr><td>2015</td><td>3.40</td></tr>
<tr><td>2016</td><td>3.20</td></tr>
<tr><td>2017</td><td>3.00</td></tr>
<tr><td>2018</td><td>2.80</td></tr>
<tr><td>2019</td><td>2.70</td></tr>
<tr><td>2020</td><td>2.50</td></tr>
<tr><td>2021</td><td>2.50</td></tr>
<tr><td>2022</td><td>2.50</td></tr>
<tr><td>2023</td><td>2.50</td></tr>
<tr><td>…</td><td>…</td></tr>
<tr><td>Year n</td><td>2.50</td></tr>
</table>
Then, the values to be applied are:
2016: 3.2 ,
2017: 3
2018: 2.8
2019: 2.7
2020: 2.5
2021: 2.5
2022: 2.5
2023: 2.5</td></tr>
<tr><td>Choice of data or Measurement methods and procedures</td><td>NA</td></tr>
<tr><td>Purpose of data</td><td>Used in baseline emission calculation</td></tr>
<tr><td>Additional comment</td><td>The decrease in the value for the baseline emission factor over time is to reflect the technological development</td></tr>
</table>

Data / Parameter	$P_{product,max}$
Unit	100 % t HNO_3/year
Description	Design capacity of nitric acid production during the second crediting period, which in this case is equal to the design capacity during the first crediting period.
Source of data	Fertinal plant operator
Value(s) applied	224,940
Choice of data or Measurement methods and procedures	NA
Purpose of data	Used in baseline emission calculation
Additional comment	This parameter is only for project activities applying case 1 of ACM0019, such as Fertinal thathas used AM0034 in the first crediting period.

Data / Parameter	GWP_{N2O}

Unit	t CO_2e/t N_2O
Description	Global warming potential of N_2O valid for the commitment period
Source of data	Relevant decisions by the CMP
Value(s) applied	298
Choice of data or Measurement methods and procedures	NA
Purpose of data	NA
Additional comment	NA

Data / Parameter	**Ru**
Unit	Pa.m^3/kmol.K
Description	Universal ideal gases constant
Source of data	
Value(s) applied	8,314
Choice of data or Measurement methods and procedures	NA
Purpose of data	Used in project emission calculation
Additional comment	NA

Data / Parameter	**MM_{N2O}**
Unit	kg/kmol
Description	Molecular mass of N_2O
Source of data	
Value(s) applied	44.02
Choice of data or Measurement methods and procedures	NA
Purpose of data	Used in project emission calculation
Additional comment	NA

B.6.3. Ex ante calculation of emission reductions

>>

Calculation of baseline emissions

As was mentioned in section B.6.1 the following equations are used in baseline emission estimation:

$$BE_y = \left(min\{P_{production,y}\,; P_{product,max}\} \times EF_{existing,y} + max\,\{P_{production,y} - P_{product,max}; 0\} \times EF_{new,y}\right) \times \frac{(h_y - h_{r,y})}{h_y} \times GWP_{N2O} \times 10^{-3}$$

$$EF_{existing,y} = \min(EF_{historical}\,; EF_{default,y})$$

The following data is used in the above equations

$EF_{historical}$= 5.71kg N_2O/t HNO_3

$EF_{default,y}$for the years included in the crediting period is listed the following Table

Table 1: $EF_{default,y,}$ Source: ACM0019 ver 2.0 page, 13

Year	Medium pressure plants (200- 600 KPa)
2016	7.8
2017	7.6
2018	7.4
2019	7.2
2020	7
2021	6.8
2022	6.6
2023	6.4

$EF_{historical} < EF_{default,y}$for the entire crediting period, then $EF_{existing,y} = EF_{historical}$

$EF_{existing,y}$ =5.71kg N_2O/t HNO_3 Equation (11)

$EF_{new,y}$for the crediting period is listed in the Table below

Table 2: $EF_{new,y.}$ Source: ACM0019 ver 2.0, page 14.

Year	Emission Factor (kg N_2O/t HNO_3)
2016	3.2
2017	3.0
2018	2.8
2019	2.7
2020	2.5
2021	2.5
2022	2.5
2023	2.5

Table 3: Other parameters required

Parameter	Values	Units	Source
$P_{production,y}$	177,211	t HNO_3	Estimated from Fertinal historical records
$P_{produc,max}$	224,940	t HNO_3	Design capacity (See section B.6.2)
h_y	8,280	hours	Estimated from Fertinal historical records
$h_{r,y}$	629	hours	Estimated from Fertinal historical records
GWP	298	t CO_2/t N_2O	See section B.6.2

Using the above mentioned data and Equation 11, Equation 12 is obtained:

$$BE_y = \left(177{,}211 \times 5.71 + 0 \times EF_{new,y}\right) \times \frac{(8{,}280-629)}{8{,}280} \times 298 \times 10^{-3} = 278{,}622\ t\ CO_2e/y$$

Equation (12)

Calculation of project emissions

The following equations are used in project emission estimations**.**

$$PE_y = PE_{N2O,y} + PE_{CO2,tertiary,y}$$

$$PE_{N2O,y} = \sum_{1}^{h_y - h_{r,y}} F_{N2O,tail\ gas,h} \times GWP_{N2O} \times 10^{-3}$$

$$F_{N2O,tail\ gas,h} = V_{h,db} \times v_{N2O,h,db} \times \rho_{N2O,h}$$

$$\rho_{N2O,h} = \frac{P_h \times MM_{N2O}}{R_u \times T_h}$$

$$PE_{CO2,tertiary,y} = 0$$ Equation (13)

$PE_{N2O,y}$ is calculated using monitored values of Fertinal plant for parameters, $V_{h,db}$, $v_{N2O,h,db}$, P_h, and T_h. Constants contained in Table 4 are applied in $\rho_{N2O,h}$ calculation.

Table 4: Constants applied in $\rho_{N2O,h}$ calculation

Parameter	Values	Units
MM_{N2O}	44.02	kg/kmol
R_u	8,314	Pa.m3/kmol.K

Data used in the calculation were monitored during the first crediting period of the project in years, 2011, 2012, and 2013. Average of annual project emission of those years is used in the present estimation.
The above mentioned approach was used since methodology ACM0019 ver 2.0 does not state a specific method to perform the ex- ante calculation of emission reduction. Moreover, the estimation obtained using actual monitored data is the best estimation that can be performed.

Table 5: PE calculated from Fertinal monitored data

Year	PE (t CO_2/y)
2011	26,376
2012	26,865
2013	31,189

Then, Equation 14 and 15 are obtained,

$$PE_{N2O,y} = 28{,}143\ t\ CO_2e/y$$ Equation (14)

$$PE_y = 28{,}143\ t\ CO_2e/y + 0 = 28{,}143\ t\ CO_2e/y$$ Equation (15)

Emission reduction calculation

$$ER_y = BE_y - PE_y$$

The obtained values of BE_y and PE_y are replaced in Equation 16

$$ER_y = 278{,}622\ t\frac{CO_2e}{y} - 28{,}143\ t\frac{CO_2e}{y} = 250{,}479\ t\frac{CO_2e}{y}$$ Equation (16)

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

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
2016	60,570	6,118	0	54,452
2017	278,622	28,143	0	250,479
2018	278,622	28,143	0	250,479
2019	278,622	28, 143	0	250,479
2020	278,622	28,143	0	250,479
2021	278,622	28,143	0	250,479
2022	278,622	28,143	0	250,479
2023	218,052	22,025	0	196,027
Total	1,950,352	197,003	0	1,753,350
Total number of crediting years	7			
Annual average over the crediting period	278,622	28,143	0	250,479

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data / Parameter	$P_{production,y}$
Unit	t HNO3
Description	Nitric acid produced in year y
Source of data	Measurements by project participants and production reports
Value(s) applied	177,211 (value used in ex-ante calculation)
Measurement methods and procedures	Daily production is measured by an accurate magnetic type flow meter, and corrected by the average of several concentration check-ups performed in the analytical lab. The concentration check-up is done according to the 02I-328-T instruction “Determination of the HNO3 %. Volumetric method”.
Monitoring frequency	Every monitoring period
QA/QC procedures	Critical instruments are calibrated on a routine basis according to the plant’s maintenance program and following QA/QC supplier recommendations.
Purpose of data	Baseline emission calculation
Additional comment	NA

Data / Parameter	h_y
Unit	h
Description	Number of hours of operation in year y
Source of data	Measured
Value(s) applied	8,280 (value used in ex-ante calculation)
Measurement methods and procedures	Plant operating status is determined on the basis of present thresholds for oxidation temperature and ammonia flow to the oxidation reactor.
Monitoring frequency	Every monitoring period

QA/QC procedures	Critical instruments are calibrated on a routine basis according to the plant's maintenance program.
Purpose of data	Project emission calculation
Additional comment	Records to be maintained during project's lifetime

Data / Parameter	$\mathbf{h_{r,y}}$
Unit	h
Description	Number of hours (*h*) in year *y* where: (a) For secondary N_2O abatement. Abatement system was not installed, underperforming or failed; (b) For tertiary N_2O abatement. The abatement system is by-passed, underperforming or failed
Source of data	Measured
Value(s) applied	629 (value used in ex-ante calculation)
Measurement methods and procedures	NA
Monitoring frequency	Every monitoring period
QA/QC procedures	
Purpose of data	Project emission calculation
Additional comment	Records to be maintained during project's lifetime

Data / Parameter	$\mathbf{V_{h,db}}$
Unit	m³ dry gas/h
Description	Volumetric flow of the gaseous stream in the hour *h* on a dry basis
Source of data	Gas volume flow meter
Value(s)applied	80,400
Measurement methods and procedures	Stack flow is measured by an ANNUBAR device (multiple pressure differential principle) with independent probe to measure temperature.
Monitoring frequency	Continuously
QA/QC procedures	Regular calibrations according to vendor specifications and recognized industry standards (EN 14181).
Purpose of data	Project emission calculation
Additional comment	Average value based on actual data monitored during the first crediting period of the project. This value was not used in ex-ante calculation

Data / Parameter	$\boldsymbol{v_{N2O,h,db}}$
Unit	m³ N_2O/m³ dry gas
Description	Volumetric fraction of N_2Oin a hour *h* on a dry basis
Source of data	0.00020
Value(s) applied	Continuously
Measurement methods and procedures	N_2O concentration is measured by on-line analyzer (Non Dispersive Infrared principle). A gas stream is continuously drawn from the stack by the sampling system under proper conditions (the line is heat traced to avoid condensation),and driven to the infrared cell. The device is set up to measure concentration and record the output electronically every 2 seconds.
Monitoring frequency	Continuously
QA/QC procedures	Regular calibrations according to vendor specifications and recognized industry standards (EN 14181).

Purpose of data	Project emission calculation
Additional comment	Average value based on actual data monitored during the first crediting period of the project. This value was not used in ex-ante calculation

Data / Parameter	T_h
Unit	K
Description	Temperature of the gaseous stream in the hour *h*
Source of data	Temperature probe (part of gas volume flow meter set up)
Value(s)applied	367
Measurement methods and procedures	The probe is a thin film platinum RTD device to measure temperature. The analog signal is sent to the Data Acquisition Unit (DAU).
Monitoring frequency	Continuously
QA/QC procedures	Regular calibrations according to vendor specifications and recognized industry standards (EN 14181).
Purpose of data	Project emission calculation
Additional comment	Average value based on actual data monitored during the first crediting period of the project. This value was not used in ex-ante calculation

Data / Parameter	P_h
Unit	Pa
Description	Pressure of the gaseous stream in the hour *h*
Source of data	Probe (part of gas volume flow meter)
Value(s)applied	87,490
Measurement methods and procedures	Stack pressure is measured by the ANNUBAR instrument. The analog signal is sent to the Data Acquisition Unit (DAU).
Monitoring frequency	Continuously
QA/QC procedures	Regular calibrations according to vendor specifications and recognized industry standards (EN 14181).
Purpose of data	Project emission calculation
Additional comment	Average value based on actual data monitored during the first crediting period of the project. This value was not used in ex-ante calculation

B.7.2. Sampling plan

>>
NA

B.7.3. Other elements of monitoring plan

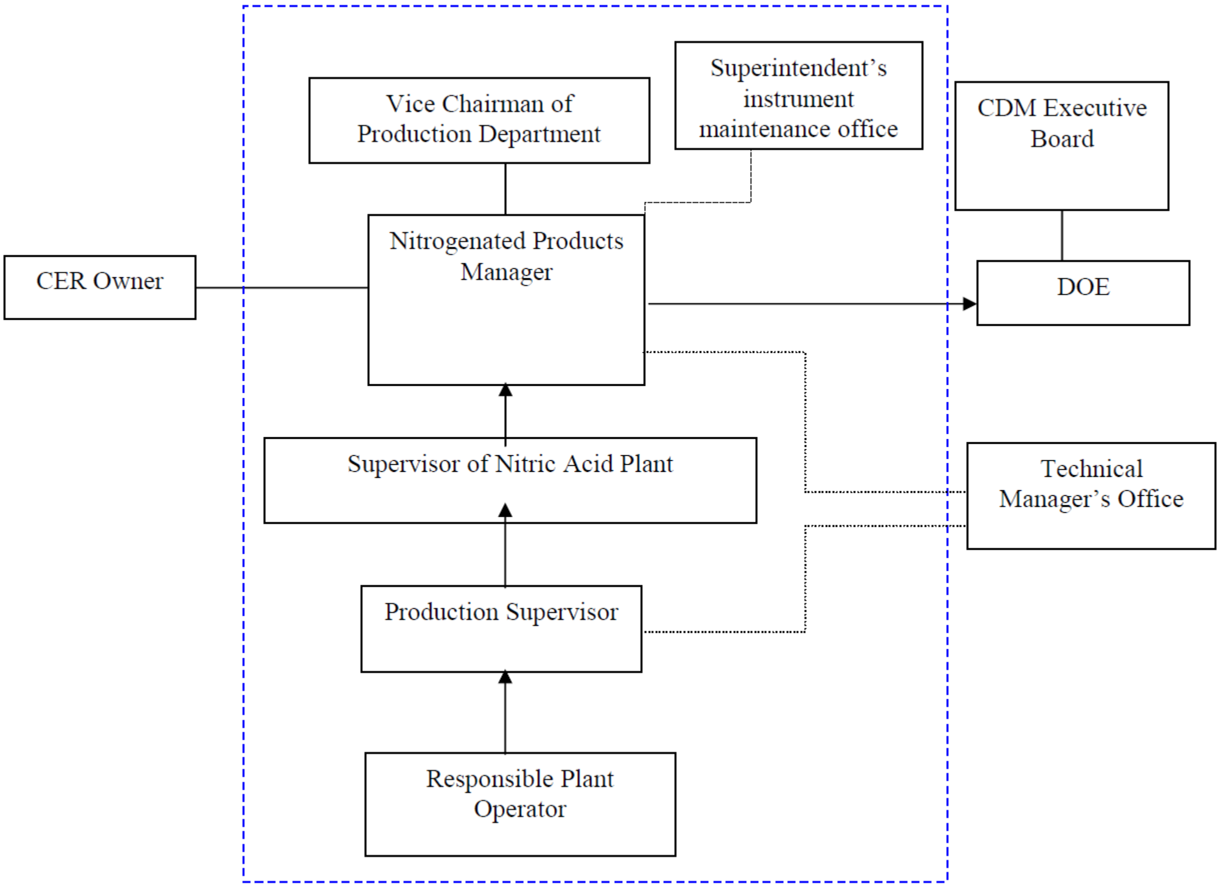
>>
The current CDM project “Fertinal Nitrous Oxide Abatement Project” will measure on a quasi-continuous basis (uninterrupted sampling of flue gases with concentration and normalized flow analysis on short, discrete time periods) the N_2O mass flow leaving the Nitric acid plant through an Automated Measuring System (AMS11) using technologies and procedures in accordance with ACM0019: “Large-scale Consolidated Methodology- N_2O Abatement from nitric acid production”.

The plant manager will be responsible for the ongoing operation and maintenance of the N_2Omonitoring system. Operation, maintenance, calibration and service intervals will be according to the manufacturer specifications and international standards (see QA/QC section below), and incorporated into the management structure procedures.

The proposed CDM project will be closely monitored, metered and recorded. The management and operation of the proposed nitrous oxide abatement project at Fertinal plant will be the responsibility ofthe Fertinal Nitrogenated products management staff. The emission reductions will be verified at by an independent entity, which will be a Designated Operational Entity (DOE).

A periodic reporting of the emission reductions generated by the project will be emitted to the CERs owner, coincidently with the DOE verification.

An illustrative scheme of the operational and management structure that will monitor the proposed CDM project activity is as follows:



The dashed line shows the operational and management structure boundaries of the proposed project.

A more detailed description of the monitoring plan is given in Annex 5 below

B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

>>

18/03/2016

María Inés Hidalgo, HerzaGlobal (not project participants)

Email: ihidalgo@herzaglobal.com

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>
20/10/2008. This is the date when the monitoring equipment was purchase.

C.1.2. Expected operational lifetime of project activity

>>
30 years

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>
Renewable- Second crediting period.

C.2.2. Start date of crediting period

>>
17/10/2016

C.2.3. Length of crediting period

7 years, until 16/10/2023

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
Fertinal Nitrous Oxide Abatement Project involves the installation of secondary catalysts whose only purpose and effect is the decomposition of nitrous oxide once it is formed. Waste N_2O is converted into N_2 and O_2, avoiding the high global warming effects of the GHG.

The installation of secondary catalysts has a positive environmental impact because it reduces N_2O emissions to the atmosphere and thereby results in cleaner overall air quality. The project activity involves the installation of a secondary catalyst system inside the reactor immediately underneath the primary gauze system. The exhausted catalyst is removed and replaced by the technology provider, who has developed the selected technology. No waste liquids, solids or gases are generated by using this technology. No further environmental impacts are expected.

Thus, an environmental impact assessment (EIA) is not necessary for this activity as it is drawn from the applicable national regulation on the subject (Ley General del Equilibrio Ecológico y Protección alAmbiente, chapter 6). Fertinal nitric acid plant is in compliance with the atmospheric emission regulation as indicated in the environmental licence (Licencia Ambiental Única) issued by the National Resources Secretariat (SEMARNAT).

D.2. Environmental impact assessment

>>

No significant negative environmental impacts are expected from the implementation of the project activity. An environmental impact study is not required by Mexican authorities.

SECTION E. Local stakeholder consultation

E.1. Solicitation of comments from local stakeholders

>>

According to the SEMARNAT (Secretariat of Natural Resources and Environment)[2] , the way to conduct the local stakeholder consultation process is established according to "La Guía Latinoamericana para proyectos MDL"[3]. The stakeholder consultation process for the Fertinal Nitrous Oxide Abatement Project was carried out according to these rules.

An invitation letter was sent to the main stakeholders, communicating Fertinal's intention of submitting a greenhouse gas emission reduction project to the national and international authorities in order to generate carbon credits in the international market. The letters were addressed to the main representatives of the following entities and the acknowledgements of receipt are available:

- Arcelor Mittal S.A. de C.V.
- Containers Station Office of Lazaro Cárdenas City Foreign Trade Zone
- Electricity Federal Commission (CFE)
- Petróleos Mexicanos (PEMEX)
- Carbonser S.A. de C.V.
- Integral Port Authority Administration
- Lázaro Cárdenas Port Customs
- Lázaro Cárdenas Institute of Technology
- National Chamber of the Construction Industry

From September 23rd to September 25th, a campaign to inform the community was held. It consisted of conducting presentations of the project presentations in all the above facilities and a meeting with the students of the Lázaro Cárdenas Institute of Technology and with the president of the National Chamber of the Construction Industry. All the people were invited to attend the public presentation, but some of them were visited directly in their offices due to their lack of time.

The invitations were sent to the different sectors as follows:

- Academic sector
- Local government entities
- Private sector

The following table lists the 64 people who were informed through the presentation about the project activity (what is climate change, the implications of climate change, international actions, local actions, the importance of the project on Mexico's greenhouse gases emissions):

Name	Position	Company/Institution
1. Arquitecto Martín Torres Caojol	President	Mexican Chamber of the Construction Industry
2. Fernando Andrade Delgado	General Manager	Carbonser S.A. de C.V.
3. Federico Rodríguez Claudio	Dock Master	Carbonser S.A. de C.V.
4. Graciano Cruz	Maintenance Supervisor	Carbonser S.A. de C.V.
5. Luis Roberto Rodríguez Járroqui	Operation Supervisor	Carbonser S.A. de C.V.

[2] www.semarnat.gob.mx

[3] www.semarnat.gob.mx/queessemarnat/politica_ambiental/cambioclimatico/Pages/mdl.aspx

6. Fernando Razo López	Student	Lázaro Cárdenas Institute of Tecnology
7. Salvador Bravo Arriaga	Chief of Official Protection	Lázaro Cárdenas, Terminal Portuaria de Contenedores
8. Carlos O. Sanperio Guasco		
9. Sarahí Abarca Domínguez	Student	Lázaro Cárdenas Institute of Tecnology
10. Roselia Rosendiz Rangel	Student	Lázaro Cárdenas Institute of Tecnology
11. Ma. Luis Santiago Vázquez	Student	Lázaro Cárdenas Institute of Tecnology
12. Audelia Margarita Gaxiola Carrazco	Student	Lázaro Cárdenas Institute of Tecnology
13. J. Jesús Cervántes Jiménez	Student	Lázaro Cárdenas Institute of Tecnology
14. Ramírez Calderón Carolina	Student	Lázaro Cárdenas Institute of Tecnology
15. José Arturo Tapia Toledo	Student	Lázaro Cárdenas Institute of Tecnology
16. Jacqueline Gonzalez Magaña	Student	Lázaro Cárdenas Institute of Tecnology
17. Jose Alejandro Ortega Urbina	Student	Lázaro Cárdenas Institute of Tecnology
18. Hugo Alberto Torres Basurto	Student	Lázaro Cárdenas Institute of Tecnology
19. Esveidi Montserrat Valdovinos García	Student	Lázaro Cárdenas Institute of Tecnology
20. Jesús Alemán Torres	Studen	Lázaro Cárdenas Institute of Tecnology
21. Leodegarlo López Martínez	Student	Lázaro Cárdenas Institute of Tecnology
22. Olga Amaranta Rosales Madrigal	Student	Lázaro Cárdenas Institute of Tecnology
23. Adrián Madrigal Ponce	Student	Lázaro Cárdenas Institute of Tecnology
24. José Guadalupe Gómez Gómez	Student	Lázaro Cárdenas Institute of Tecnology
25. Díaz Rodríguez Laura Selene	Student	Lázaro Cárdenas Institute of Tecnology
26. Ivonne Adame Moreno	Student	Lázaro Cárdenas Institute of Tecnology
27. Torres Santana Doris Paulina	Student	Lázaro Cárdenas Institute of Tecnology
28. Ana Lilia Juárez Saavedra	Student	Lázaro Cárdenas Institute of Tecnology
29. Torres Cano Irma Eloisa	Student	Lázaro Cárdenas Institute of Tecnology
30. Bernardeth Alejandra García Villarruel	Student	Lázaro Cárdenas Institute of Tecnology
31. Cynthia Berenice Bargas de la Cruz	Student	Lázaro Cárdenas Institute of Tecnology
32. Adriana Patricia Ceballos Huerta	Student	Lázaro Cárdenas Institute of Tecnology
33. Peñaloza Villafán Alondra Esbeidi	Student	Lázaro Cárdenas Institute of Tecnology
34. Fabiola Bejarano Rebolledo	Student	Lázaro Cárdenas Institute of Tecnology
35. Karen Alicia Peñaloza Vargas	Student	Lázaro Cárdenas Institute of Tecnology
36. Irio Mayela Díaz Chávez	Student	Lázaro Cárdenas Institute of Tecnology
37. María de Lourdes Rebolledo García	Teacher	Lázaro Cárdenas Institute of Tecnology
38. David Gómez Velázquez	Pipeline Maintenance Responsible	PEMEX Refining
39. Tomás Morales C.	Terminal Supervisor	PEMEX Refining
40. Omar Castellanos Acosta	Maintenance Officer	PEMEX Refining
41. R. Álvarez P.	Operation Chief	PEMEX Refining
42. Sergio Antonio Guerrero Márquez	Industrial Security and Environment Protection Supervisor	PEMEX Refining
43. Raúl Higareda Herrera	Industrial Security and Environment Department Chief	PEMEX Refining
44. Raúl Martínez Villegas	General Supervisor of Zone	Federal Comission of Electricity (CFE)

45. Victor M. Gómez Bautista	Department of Substations	Federal Comission of Electricity (CFE)
46. Omar Dionicio Zamora	Leader of Construction Process	Federal Comission of Electricity (CFE)
47. Silvia Reyes Sánchez	Chief of Administrative Office	Federal Comission of Electricity (CFE)
48. Juan Adrián Rodrígez	Communication & Control	Federal Comission of Electricity (CFE)
49. Raúl Alcantar Quiroz	Personnel Chief	Federal Comission of Electricity (CFE)
50. Ricardo Ponce Martínez	Security Supervisot	Federal Comission of Electricity (CFE)
51. J. Eulalio Quiróz Medina	Department Chief	Federal Comission of Electricity (CFE)
52. Rolando Pérez Santos	Supervisor	Federal Comission of Electricity (CFE)
53. Jesús Ortíz Sandoval	Department Chief	Federal Comission of Electricity (CFE)
54. Hugo Saldaña	Commercialization	Federal Comission of Electricity (CFE)
55. Rafaél Ayula Pérez	Department Chief	Federal Comission of Electricity (CFE)
56. Antonio Guasardo	Department Chief	Federal Comission of Electricity (CFE)
57. Rogelio Ávila Rivera	Environment Supervisor	Federal Comission of Electricity (CFE)
58. Mariano Montejano Vega	Ecology and Contingencies Supervisor	Arcelor Mittal S.A de C.V.
59. Dulce María de los Angeles Cortés Parédes	Supervisor of CO_2	Arcelor Mittal S.A de C.V.
60. Eladio Morales Paniagua	Superintendent of Storage Department and Evaporation of Phosphoric Acid	Fertinal Plant
61. Victor Manuel Martínez Mellín	Instrument Department Supervisor	Fertinal Plant
62. Edson Reynosa Ramírez	Instrument Department Chief	Fertinal Plant
63. Jorge Alfredo Cerdo García	Supervisor of Instrument Maintenance	Fertinal Plant
64. Manuel Luna Covarrubias	Instrument Supervisor	Fertinal Plant

Support material:

- Presentation
- Invitations
- Summary of explanation of climate change

Figure 8. Stakeholders' meeting at Federal Commission of Electricity (CFE)

Figure 9. Stakeholders' meeting with the students of Technical Institute of Lázaro Cárdenas

	PROYECT OF NITROUS OXIDE ABATEMENT FERTINAL GROUP	

YOUR OPINION IS IMPORTANT FOR US

With reference on the information that you have and based on your knowledge and your consciousness about themes related to Environment, Climate Change, Kyoto Protocol, the Clean Development Mechanism and the Mechanisms for a Clean Development; briefly express your opinion about nitrous oxide project abatement in Fertinal Group S.A. de C.V. …… …… ……
Would you recommend the private industries, government authorities and other organizations to develop projects of this nature: reduction of global warming gases under clean development mechanisms? …… …… ……
Do you consider that the abatement project of nitrous oxide, by Grupo Fertinal S.A. de C.V., will contribute to the social development, economic, environmental or sustainability of the region and Mexico (sustainable development is understood as “development that satisfies the necessities of the present generations without committing the possibilities of the future generations to attend their own necessities”)? …… …… ……
Additional comments that you like to express: …… …… ……

Please write your data:

- Name and last name:
- Institution/Organization in which you work:
- Function:
- E-mail:

Signature:

Please, deliver this formulary at the end of the meeting. Don't doubt on consulting if you have any concern.

-

E.2. Summary of comments received

>>

In general, the comments obtained regarding to the project presentation were positive. Some remarkable aspects mentioned were the contribution of this type of projects towards improving the interest of other industries in global warming. Most of the participants expressed their awareness of projects that reduce GHG emissions. The project's contribution to greenhouse gas mitigation was clearly understood

E.3. Report on consideration of comments received

>>

As the comments received were favourable, no adjustment in the project was necessary

SECTION F. Approval and authorization

>>

A letter of approval and authorization have been provided by the Mexican DNA

Appendix 1. Contact information of project participants and responsible persons/ entities

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Impulso Ecologico y Desarrollo Sustentable, SA de CV
Street/P.O. Box	Av. Prolongacion Paseo de la Reforma
Building	No. 1015Tower A 1st Floor,
City	Col. Santa Fe, Deleg. Alvaro Obregon, Distrito Federal
State/Region	Distrito Federal
Postcode	01376
Country	Mexico
Telephone	*+(52)55 91 50 74 61*
Fax	*+(52)55 91 50 74 52*
E-mail	NA
Website	NA
Contact person	
Title	President
Salutation	Mr
Last name	Fajer
Middle name	NA
First name	Antonio
Department	Presidence
Mobile	NA
Direct fax	*+(52)55 91 50 74 52*
Direct tel.	*+(52)55 91 50 74 61*
Personal e-mail	afajer@impeco.com.mx

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Impulso Ecologico y Desarrollo Sustentable, SA de CV
Street/P.O. Box	Av. Prolongacion Paseo de la Reeforma
Building	No. 1015 Tower A 1st Floor,
City	Col. Santa Fe, Deleg. Alvaro Obregon, Distrito Federal
State/Region	Distrito Federal
Postcode	01376
Country	Mexico
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Fax	*+(52)55 91 50 74 52*
E-mail	NA
Website	NA

Contact person	
Title	Project Director
Salutation	Mr
Last name	Pasalagua
Middle name	Branch
First name	Gerardo
Department	Board
Mobile	044 55 27 55 63 84
Direct fax	*+(52)55 91 50 74 52*
Direct tel.	*+(52)55 91 50 74 61*
Personal e-mail	*gpasalagua@impeco.com.mx*

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Nordic Environment Finance Corporation
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City	Helsinki
State/Region	Helsinki
Postcode	00171
Country	Fiji
Telephone	+358 (0)10 618 003
Fax	+358 9 630 976
E-mail	info@nefco.fi
Website	http://www.nefco.org/
Contact person	
Title	
Salutation	Ms
Last name	Lindegaard
Middle name	NA
First name	Helle
Department	
Mobile	NA
Direct fax	+358 9 630 976
Direct tel.	+358 (0)10 6180 664
Personal e-mail	helle.lindegaard@nefco.fi

Project participant and/or responsible person/ entity	☒ Project participant ☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Nordic Environment Finance Corporation
Street/P.O. Box	Fabianinkatu/P.O. Box 241
Building	No34

City	Helsinki
State/Region	Helsinki
Postcode	00171
Country	Fiji
Telephone	+358 (0)10 618 003
Fax	+358 9 630 976
E-mail	info@nefco.fi
Website	http://www.nefco.org/
Contact person	
Title	
Salutation	Ms
Last name	Nyberg
Middle name	NA
First name	Tina
Department	
Mobile	
Direct fax	+358 9 630 976
Direct tel.	+358 (0)10 6180 651
Personal e-mail	tina.nyberg@nefco.fi

Project participant and/or responsible person/ entity	☐ Project participant ☒ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity
Organization name	Herza Global
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Postcode	1428
Country	Argentina
Telephone	+54 11 4925 8998
Fax	NA
E-mail	info@herzaglobal.com
Website	www.herzaglobal.com
Contact person	
Title	Project Manager
Salutation	Eng
Last name	Hidalgo
Middle name	Inés
First name	María
Department	Technical
Mobile	+45 911 5990 8734
Direct fax	NA
Direct tel.	NA
Personal e-mail	ihidalgo@herzaglobal.com

Appendix 2. Affirmation regarding public funding

No public funds were available for the financing of the project activity. Therefore, Fertinal financed the project activity on the expectation of its approval.

Appendix 3. Applicability of methodology and standardized baseline

The proposed project activity, selected the methodology ACM0019 “Large-scale Consolidated Methodology: N_2O abatement from nitric acid production” (Version 02.0), which replaced methodology AM0034 used by the project during the first crediting period.
The project did not apply any standardized baseline

Appendix 4. Further background information on ex ante calculation of emission reductions

Detailed explanation on how the ex- ante emission reduction calculations were performed is included in section B.6.3.

Table 6 containing all the parameters used in the above mentioned calculation is included below as summary.

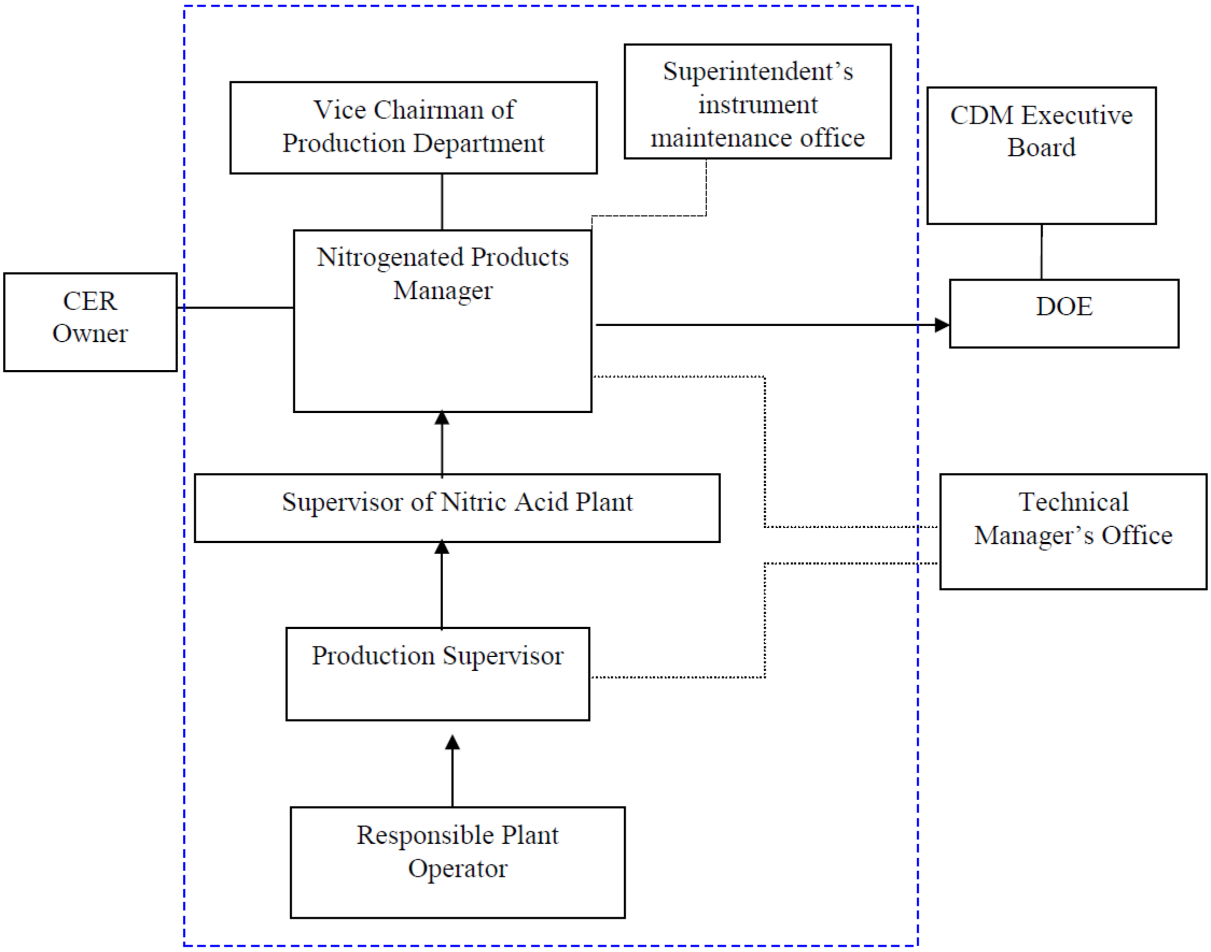
Table 6: Parameters used in ex- ante calculations

Parameter	Values	Units	Source
$P_{production,y}$	177,211	t HNO_3	Estimated from Fertinal historical records
$P_{produc,max}$	224,940	t HNO_3	Reactor design data
$EF_{historical}$	5.71	kg N_2O/t HNO_3	Calculated at the baseline campaign
$EF_{default,y}$	See Table 1	kg N_2O/t	ACM0019
$EF_{new,y}$	See Table 2	kg N_2O/t	ACM0019
h_y	8,280	hours	Estimated from Fertinal historical records
$h_{r,y}$	629.28	hours	Estimated from Fertinal historical records
GWP_{N2O}	298	t CO_2/t N_2O	IPCC
$PE_{N2O,y}$	28,952	t CO2/y	Calculated from Fertinal historical monitored data according to equations 6,7,8 and 9

The parameter $EF_{historical}$ was calculated at the baseline campaign which took place from August 17th, 2009 to January 3rd, 2010, following the principles stated in AM0034. Complete baseline calculation is in document “Fertinal-EFBL-rev 1.3.xls”

Appendix 5. Further background information on monitoring plan

The current CDM project “Fertinal Nitrous Oxide Abatement Project” is measure on a quasi continuous basis (uninterrupted sampling of flue gases with concentration and normalized flow analysis on short, discrete time periods) the N_2O mass flow leaving the nitric acid plant through an Automated Measuring System (AMS14) using technologies and procedures in accordance with
ACM0019: “N_2O abatement from nitric acid production”. The monitoring procedures (deployed as per the current monitoring plan and being an integral part of it), are integrated into the operating CDM Manual of Fertinal’s nitrous oxide abatement project.
Training required as a consequence of the CDM project implementation were developed and included as part of the CDM project manual. Before beginning the baseline campaign staff involved in the operation and maintenance of the AMS, were trained to manage the new monitoring units installed as a consequence of the project activity. Documented evidence of such training is available on site for auditing purposes. Monitoring of the national regulation related to NO_X and N_2O were also established as a written procedure and integrated into the project’s CDM manual.
The plant manager is responsible for the ongoing operation and maintenance of the N_2Omonitoring system. Operation, maintenance, calibration and service intervals are according to the manufacturer’s specifications and international standards (see QA/QC section below), and incorporated into the management structure procedures.
The CDM project are closely monitored, metered and recorded. The management and operation of the nitrous oxide abatement project at Fertinal plant is the responsibility of the Fertinal Nitrogenated products management staff. The emission reductions are verified by an independent entity, which is a Designated Operational Entity (DOE). A periodic reporting of the emission reductions generated by the project are sent to the CER owner, coincidentally with the DOE verification.
An illustrative scheme of the operational and management structure that monitors the proposed CDM project activity is as follows:



Note: the dashed line shows the operational and management structure boundaries of the proposed project.
The relation between the project operational and management structure and other actors of the proposed CDM project activity is described as follows:

- The Responsible Plant Operator is in charge of the supervision of the automated measuring system (AMS) and the data acquisition system (DAS) that are installed to measure and acquire stack emission data. Supported by the DAS, the Fertinal Plant Operator reports the relevant data and events to the Production Supervisor.
- The Production Supervisor is in charge of analyzing the information provided by the plant operator and to processes the data, check for consistency and record it on an spreadsheet specially designed for the purpose of the current monitoring plan.
- The Supervisor of the Nitric Acid Plant is a member of the plant staff structure that is incharge of further validation of data as generated by the data acquisition system (DAS). The Supervisor of the Nitric Acid plant receives the information from the Fertinal Production Supervisor and guarantees proper and consistent application of the procedures during the report preparation.
- The Technical Manager's Office is considered for technical support during QA/QC activities related to the Automated Monitoring System when required.
- The function of the Superintendent's instrument maintenance office is to support, when required during the activities intended to assure the correct maintenance and operation of the data acquisition system (DAS) and the automated measuring system (AMS).
- The Fertinal Nitrogenated Products Manager is responsible of ensuring that the CDM project activity at plant level is implemented in compliance with the PDD and other relevant standards. Fertinal Nitrogenated Products Manager reports weekly to the Vice Chairman of Fertinal's Production Department as to the overall progress of the CDM project activity.

- The DOE sends the corresponding verification report to the CDM Executive Board in order to evaluate it and enable the issuance of the CERs.

The PC based Data Acquisition System (DAU) and the control panel for the Automated Measuring System (AMS) were installed inside the control room of the nitric acid plant, but independent from the control system of the plant. The installation was made in the control room because of the appropriate conditions, which guarantee the appropriate functioning of the AMS.

The instrumentation used for the measurement of the process parameters are calibrated according to a maintenance program, with the aid of reference instruments certified by EMA (Accreditation Mexican Entity). The signals generated by these instruments are acquired and logged electronically by the Distributed Control System (DCS) of the plant. The specific data generated by the AMS is stored on the DCS every 2 seconds. The DAU provides hourly averages, which at due time are transferred on to a common spreadsheet (excel) for further analysis/calculations and reporting purposes. Actual emission reduction calculation will use values from such spreadsheet. Due to space constraints on the DAU's hard-drive, from time to time, historical data is archived on a separate hard drive or CDs, to be safeguard for at least 2 years. Raw (detailed) data is accessible only through the DAU software platform, which insures the stored data cannot be manipulated.

All parameters measured during the baseline campaign were archived in electronic format during the entire crediting period.
All parameters measured during projects campaigns are archived in electronic format for at least two years.

Environmental Regulation Monitoring
An environmental regulation monitoring procedure was implemented in order to assure the quality assurance program of the plant. This procedure is applicable in all the areas where federal codes, laws, regulations or norms are involved. In regard to this project, the legal office of the plant is the team responsible to monitor, control, register, disseminate, identify and inform the new legal guidelines that would be applicable to N_2O emissions published on the Official Journal of the Federation or the Official State Journal.

Description of the AMS Fertinal selected continuous gas analyzers from the supplier ABB, model AO2000, while the specific module to measure N_2O is a non-dispersive infrared analyzer called URAS 26. The instrument descriptions according to the manufacturer are given below:

Infrared Analyzer Module Uras26

Measurement Principle

Non-dispersive infrared absorption in the λ = 2.5–8 μm wavelength range

Photometer to measure from 1 to 4 components with 1 or 2 beam paths and 1 or 2 receivers in each beam path

Sample Components and Smallest Measurement Ranges

The Uras26 analyzer module has one physical measurement range per sample component. As an option, smaller measurement ranges can be electronically derived from the physical measurement range. The smallest range is measurement range 1.

The smallest measurement ranges shown in the following table are based on the first sample component in beam path 1.

Sample Component	Class 1 Range	Class 2 Range	Class 2 Range with Calibration Cell	Gas Group [1]
CO	0– 50 ppm	0– 10 ppm	0– 50 ppm [2]	A
CO_2	0– 50 ppm	0– 5 ppm	0– 25 ppm [2]	A
NO	0– 75 ppm	0– 75 ppm	0– 75 ppm [2]	A
SO_2	0– 100 ppm	0– 25 ppm	0– 25 ppm [2]	A
N_2O	0– 50 ppm	0– 20 ppm	0– 50 ppm [2]	A
CH_4	0– 100 ppm	0– 50 ppm	0– 50 ppm [2]	A
NH_3	0– 500 ppm	0– 30 ppm	–	B
C_2H_2	0– 200 ppm	0– 100 ppm	0– 100 ppm	B
C_2H_4	0– 500 ppm	0– 300 ppm	0– 300 ppm	B
C_2H_6	0– 100 ppm	0– 50 ppm	0– 50 ppm [2]	B
C_3H_6	0– 250 ppm	0– 100 ppm	0– 100 ppm [2]	B
C_3H_8	0– 100 ppm	0– 50 ppm	0– 50 ppm [2]	B
C_4H_{10}	0– 100 ppm	0– 50 ppm	0– 50 ppm [2]	B
C_6H_{14}	0– 500 ppm	0– 100 ppm	0– 100 ppm [2]	B
R 134a	0– 100 ppm	0– 50 ppm	0– 50 ppm [2]	B
SF_6	0–2000 ppm	0–1900 ppm	0–2000 ppm	B
H_2O	0–1000 ppm	0– 500 ppm	0– 500 ppm	C

1) See price information
2) Measurement range 1 the smallest is shown. The largest measurement range should be at least four times larger.

Other sample components on request.

The following data apply to measurement range 1 in a delivered analyzer module.

Stability

Linearity Deviation
≤ 1 % of span
Option: Linearization for automobile exhaust gas measurement according to EPA specifications

Repeatability
≤ 0.5 % of span

Zero Drift
≤ 1 % of span per week;
for ranges smaller than Class 1 to Class 2:
≤ 3 % of span per week

Sensitivity Drift
≤ 1 % of measured value per week

Output Fluctuation (2 σ)
≤ 0.2 % of span at electronic T90 time = 5 sec (Class 1) or = 15 sec (Class 2)

Detection Limit (4 σ)
≤ 0.4 % of span at electronic T90 time = 5 sec (Class 1) or = 15 sec (Class 2)

Measurement Ranges

Quantity
1 to 4 ranges per sample component

Largest Measurement Range
0 to 100 Vol.-% or 0 Vol.-% to saturation or 0 Vol.-% to LEL
Measurement ranges within ignition limits cannot be provided.

Measurement Range Ratio
≤ 1:20

Measurement Ranges with Suppressed Zero-Point
Electronic zero-point suppression or differential measurement based on a base level > 0 with flowing reference gas, max. suppression ratio of 1:10

Measurement Range Switching
Manual; available external control or automatic

Limit Value Monitoring
Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

Calibration

Zero-Point Calibration
With inert gas, e.g. N_2, or with ambient air that is free of the sample component.

End-Point Calibration
With gas-filled calibration cells (optional) or with test gas mixtures. It is recommended to verify the calibration cell set values once a year.
During calibration of a multi-component analyzer, possible cross-sensitivity and/or carrier gas corrections by internal or external measurement components are switched off. Therefore, corrected measurement components should be calibrated only using a test gas consisting of the measurement component and an inert gas like N_2.

Influence Effects

Flow Effect
Flow rate in the 20–100 l/h range: within determination limits

Associated Gas Effect/Cross Sensitivity
The knowledge of the sample gas composition is necessary for the analyzer configuration.
Selectivity measures to reduce associated gas effect (optional): Incorporation of interference filters, filter vessels or internal electronic cross-sensitivity correction or carrier gas correction for a sample component by other sample components measured with the Uras26.

Infrared Analyzer Module Uras26

Temperature Effect
Ambient temperature in permissible range
- At zero-point: ≤ 1 % of span per 10 °C; for ranges smaller than Class 1 to Class 2: ≤ 2 % of span per 10 °C
- On sensitivity with temperature compensation: ≤ 3 % of measured value per 10 °C
- On sensitivity with thermostat effect at 55 °C (optional): ≤ 1 % of measured value per 10 °C

Air Pressure Effect
- At zero-point: No effect
- On sensitivity with pressure correction by means of integral pressure sensor: ≤ 0.2 % of measured value per 1 % barometric pressure change

The pressure sensor is located in the sample gas path if hoses are used as the internal gas lines.
If tubing is used for internal gas lines the pressure sensor is routed to the outside via a hose.
Pressure sensor working range: p_{abs} = 600–1250 hPa

Power Supply Effect
24 VDC ± 5 %: ≤ 0.2 % of span

Dynamic Response

Warm-Up Time
Approx. 30 minutes without thermostat; approx. 2 hours with thermostat

90% Response Time
T_{90} = 2.5 sec for measurement cell length = 200 mm and sample gas flow = 60 l/h without signal damping (low pass filter). Low-pass time constant adjustable from 0 to 60 sec

Materials in Contact with the Sample Medium

Analyzer (Sample Cells)
Tubing: Aluminum or gold-plated aluminum;
Window: CaF_2, Option: BaF_2;
Connectors: Rust- and acid-resistant steel 1.4571

Gas Lines and Connectors
FPM hoses and PTFE tubing with stainless steel connectors;
Option: Rust- and acid-resistant steel tubes 1.4571

Gas Connections

Layout and Design
Gas ports on back (19-inch rack housing) or bottom (wall-mount housing) of the analyzer module with 1/8 NPT internal threads for commercially available adapters, e.g. Swagelok®. See page 34 for connection drawing.

Electrical Connections

System Bus
3-pin female plug

External 24-VDC Power Supply
4-pin male plug

Gas Inlet Conditions

Temperature
The sample gas dew point should be at least 5 °C below the ambient temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Inlet Pressure
p_e = 2–500 hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure
Atmospheric pressure

Flow Rate
20–100 l/h

Corrosive Gases
Highly corrosive associated gas components, e.g. chlorine (Cl_2) and hydrogen chloride (HCl), as well as gases or aerosols containing chlorine must be cooled or undergo prior absorption. Provide for housing purge.

Flammable Gases
The analyzer module is suitable for measuring flammable gases and vapors under atmospheric conditions (p_{abs} ≤ 1.1 bar, oxygen content ≤ 21 Vol.-%). Temperature Class: T4. The sample gas must not be explosive under normal conditions. If the sample gas is explosive in the event of a sample gas supply failure, then only seldom and briefly (in accordance with Zone 2). Pressure in the sample gas path in normal operation p_e ≤ 100 hPa; in case of a sample gas supply failure the pressure must not exceed the maximum value p_e = 500 hPa. The version with gas paths designed as stainless steel tubes should be selected and housing purge with N_2 should be provided when measuring flammable gases and vapors. Before using the analyzer module the corrosion resistance against the specific sample gas must be checked.

Purge Gas
The purge gas should not contain any sample gas components.

Power Supply

Input Voltage, Power Consumption
24 VDC ± 5 %, max. 95 W

Installation Site Requirements

Vibration
max. ±0.04 mm at 5 to 55 Hz, 0.5 g at 55 to 150 Hz
Slight transient effect on sample value in the region of the beam modulation frequency

Ambient Temperature
Operation: +5 to +40/45 °C when installed in housing with/without electronics module;
Storage and transport: –25 to +65 °C

For stack flow measurement, Fertinal plant selected as primary meter an Annubar principle (multiple pressure differential) unit, model 485 Annubar primary manufactured by Rosemount Inc. (USA).
Table below summarize the specifications of the Annubar unit:

Rosemount 485 *Annubar* Primary

SPECIFICATIONS

Performance

Performance Statement Assumptions
Measured pipe I.D.

Discharge Coefficient Factor
±0.75% of flow rate

Repeatability
±0.1%

Line Sizes
- Sensor Size 1: 2-in. to 8-in. (50 to 200 mm)
- Sensor Size 2: 6-in. to 96-in. (150 to 2400 mm)
- Sensor Size 3: 12-in. to 96-in. (300 to 2400 mm)

NOTE
Some mounting types are not available in larger line sizes.

TABLE 26. Reynolds Number and Probe Width

Sensor Size	Minimum Rod Reynolds Number (R_d)	Probe Width (d) (inches)
1	6500	0.590-in. (14.99 mm)
2	12500	1.060-in. (26.92 mm)
3	25000	1.935-in. (49.15 mm)

Functional

Service
- Liquid
- Gas
- Steam

Process Temperature Limits
Direct Mount Electronics
- 500 °F (260 °C)
- 750 °F (400 °C) when used with a direct mount, high temperature 5-valve manifold (Electronics Connection Platform code 6)

Remote Mount Electronics
- 1250 °F (677 °C) – *Hastelloy* Sensor Material
- 850 °F (454 °C) – Stainless Steel Sensor Material

Pressure and Temperature Limits(1)
Direct Mount Electronics
- Up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C))
- Integral temperature measurement is not available with Flanged mounting type greater than class 600

Remote Mount Electronics
- Up to 2500# ANSI (6000 psig at 100 °F (416 bar at 38 °C)).

Good monitoring practice and performance characteristics

Regarding QA/QC, the European Norm EN 14181:2004, which is recommended as guidance regarding the selection, installation and operation of the AMS under Monitoring Methodology ACM0019, stipulates three Quality Assurance Levels (QALs), and one Annual Surveillance Test (AST):

QAL1: Suitability of the AMS for the specific measuring task.

The suitability evaluation of the measuring procedure is described in ISO 14956:2002 “Air quality – Evaluation of the suitability of a measurement procedure by comparison with a required measuring uncertainty”. Using this standard, it shall be proven that the total uncertainty of the results obtained from the AMS meets the specification for uncertainty stated in the applicable regulations (e.g. EU Directive 2000/76/EU or 2001/80/EU). Since European regulations do not yet cover the measurement of N_2O at nitric acid plants, there is no official specification for uncertainty available. Hence, considering official specification of uncertainties defined for equivalent pollutants (e.g. NO_X, SO_2)according to EU regulations, 20% of the ELV (emission limit value, in this case taken as the actual test concentration or calibration gas) has been considered by the equipment manufacturer as the required measurement quality for N_2O, for the purpose of expanded uncertainty calculations.
Table below depicts performance characteristics as per the corresponding QAL1 report.

Contributing partial standard uncertainties and reference to their origins

Selectivity H2O	0.00	ppm
Selectivity others (largest sum)	0.04	ppm
Lack of fit	0.47	ppm
Drift	0.89	ppm
Pressure dependence	0.00	ppm
Temperature dependence	1.94	ppm
Flow dependence	0.15	ppm
Voltage dependence	0.09	ppm
Repeatability	0.10	ppm
Uncertainty of response factors	0.00	ppm
Uncertainty of converter efficiency (SCC-K NOx converter)	0.00	ppm
Response time	44	seconds
Origin of data	*TÜV-Report no. 821029 (2006)*	

The overall measurement uncertainty (UNC) is calculated by summing in an appropriate manner(using the Gauss law of error propagation) all the relevant uncertainties arising from the individualperformance characteristics of the AMS components, then:

$$UNC = \sqrt[2]{N2O\ analyzer\ uncertainty^2 + \ flow\ meter\ uncertainty^2 + nitric\ acid\ flow\ meter\ uncertainty^2}$$

The overall measurement is available for auditing purposes.

QAL2: Validation of the AMS following its installation.

The next level of quality assurance prescribed in EN14181:2004 (QAL2) describes a procedure for the determination of the calibration function and its variability, by means of a certain number of parallel measurements (meaning simultaneously with the AMS), performed with a standard reference method (which should be a proven and accurate15 analytical protocol according to relevant norms or legislation). The variability of the measured values obtained with the AMS is then compared with the uncertainty given by the applicable legislation. If the measured variability is lower than the permitted uncertainty, it is concluded that the AMS has passed the variability test. Since (as explained above),official uncertainty is not available, an appropriate level is determined on the basis of those that do exist for similar pollutants and techniques (in this case 20% of ELV).

The testing laboratories performing the measurements with the standard reference method shall have an accredited quality assurance system according to EN ISO/IEC 17025 or relevant (national) standards.
Any data collected before the receipt of the QAL2 lab report is corrected through proper application of the calibration function. The UNC calculated during the QAL2 were deducted from the baseline emission factor.
As condition precedent for a QAL2 test, it is required that the AMS has been correctly installed and commissioned, considering (for example) that the AMS is readily accessible for regular maintenance and other necessary activities and that the working platform to access the AMS allows for parallel sampling. The AMS unit at Fertinal plant was installed by qualified contractors under the direct supervision of the equipment manufacturers, considering both relevant Mexican and international standards. The Plant Manager actively supervised all phases of installation, from system design to commissioning.

QAL3: Ongoing quality assurance during operation.

Procedures described in QAL3 of EN 14181: 2004 check for drift and precision, in order to demonstrate that the AMS is in control during its operations so that it continues to function within the required specification for uncertainty. This is achieved by conducting periodic zero and span checks on the AMS, and evaluating results obtained using control charts. Zero and span adjustments or maintenance of the AMS may be implemented as a result of such evaluation. The implementation and performance of the QAL3 procedures given in this standard are the responsibility of the plant (or AMS) owner.

The standard deviation according to QAL3 is calculated by the equipment manufacturer on the basis of equipment performance characteristics and field conditions for Fertinal's nitric acid plant.
The data is used to monitor that the difference between measured values and true values of zero and span reference materials are equal to or smaller than the combined drift and precision value of the AMS multiplied by a coverage factor of 2 (2 times standard deviation of AMS, as described in QAL3section of EN14181) on a weekly basis, with the aid of Shewart charts. Documented calibration procedure for weekly zero and span checks and resulting Shewart charts are available on site for verifications.
All monitoring equipment is serviced and maintained according to the manufacturer's instructions and international standards by qualified personnel (both Fertinal's resources and any third parties that may be involved during such activities). Maintenance and service logs are kept at Fertinal's plant and available for auditing purposes.

AST: Annual surveillance test (ongoing quality assurance).

The AST is a procedure to evaluate whether the measured values obtained from the AMS still meet the required uncertainty criteria, as evaluated during the QAL2 test. As the QAL2, it also requires a limited number of parallel measurements using an appropriate Standard Reference Method. Although the total expected uncertainty of the AMS is well below the selected required uncertainty, an AST had been performed to the AMS once per year. If at a later time, the DOE (Designated Operational Entity) agrees the AST is not required on a yearly basis (considering the consistent performance of the AMS), the periodicity will be modified accordingly.

Appendix 6. Summary of post registration changes

There isn't any post registration change for Fertinal project.