



**CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006**

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

Project for the catalytic reduction of N₂O emissions with a secondary catalyst inside the ammonia reactor of the N1 & N2 nitric acid plants at Haifa Chemicals Ltd., Israel.

Version 1.0, date of completion: 12th April 2007

A.2. Description of the project activity:

The sole purpose of the proposed project activity is to significantly reduce current levels of N₂O emissions from the production of nitric acid at two of Haifa Chemicals' nitric acid plants (the "N1 & N2 Plants") at Haifa Bay, Israel. The N1 & N2 nitric acid plants were designed by Stami Carbon and commissioned in 1967 and 1976; N1 and N2 are single burner low & medium pressure plants operated at 4 respectively 7 bar gauge.

Haifa Chemicals is a principal producer and supplier of commercial fertilizers, mostly potassium nitrate.

To produce nitric acid, ammonia (NH₃) is reacted with air over precious metal – normally a platinum-rhodium (Pt-Rh) alloy – catalyst gauze pack in the ammonia oxidation reactor of nitric acid plants. The main product of this reaction is NO, which is metastable at the conditions present in the ammonia oxidation reactor and therefore reacts with the available oxygen to form NO₂, which is later absorbed in water to form HNO₃ – nitric acid. Simultaneously, undesired side reactions yield nitrous oxide (N₂O), nitrogen and water. N₂O is a potent greenhouse gas with a Global Warming Potential (GWP) of 310¹ which is usually emitted into the atmosphere.

The project activity involves the installation of a new N₂O abatement technology; a pelletised catalyst that will be installed inside the ammonia oxidation reactor, underneath the precious metal gauzes. It is expected that this catalyst will reduce between 80% and 90% of current N₂O emissions.

The project transfers a new, clean technology to Israel that is not even common industrial practice in Annex 1 countries. Also, the project will lead to an enhancement of skills as employees will be trained to operate both the N₂O abatement catalyst and the Automated Monitoring System ("AMS").

Haifa Chemicals is certified according to ISO 9001 and 14001 standards for quality and environmental management respectively. Also, Haifa Chemicals is certified in accordance with OSHA 18001, the U.S. Occupational Health and Safety Agency standard. The procedures for monitoring, regular calibrations and QA/QC are fully embedded into the procedures required by ISO 9001/14001 and documented in the applicable ISO handbooks.

The financial benefits from the sale of Certified Emission Reductions ("CERs") will be used to offset the capital and operating costs of the project to provide for its continued operation throughout the crediting period.

Through the sale of CERs, Haifa Chemicals will also be able to improve its profitability and ensure employment, contribute to economic prosperity in the region as well as invest in further clean technologies to improve its environmental performance.

¹ IPCC Second Assessment Report (1995)

**A.3. Project participants:**

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project par- ticipant (Yes/No)
Israel	Haifa Chemicals Ltd., Israel ("Haifa Chemicals").	No
Germany	N.serve Environmental Services GmbH, Germany ("N.serve").	No

A.4. Technical description of the project activity:**A.4.1. Location of the project activity:****A.4.1.1. Host Party(ies):**

Israel

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

Not applicable.

A.4.1.3. City/Town/Community etc:

Haifa Bay, Israel

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

Haifa Chemicals operates two nitric acid plants on this site (N1 and N2). The postal address is POB10809 Haifa Bay 26120. This PDD covers both nitric acid plants operated at this location. The Haifa North site is located at 32°47'27.5" N latitude and 35°03'56.7" E longitude, approximately².

Haifa Chemicals intends to implement other CDM project activities at two plants on its South site. These plants – named N3 and N4 – are located near Mishor Rotem which is several hundred kilometers away from Haifa Bay. The project activity subject to this PDD is independent of the ones that are to be implemented at the South site.

A PDD covering the N3 plant has been submitted for validation and initializing the Global Stakeholder Consultation Process on 17th Nov 06. Another PDD for N4 will be submitted for validation in the near future.

² Coordinates according to Google Earth©, version 4.0.291 (beta)

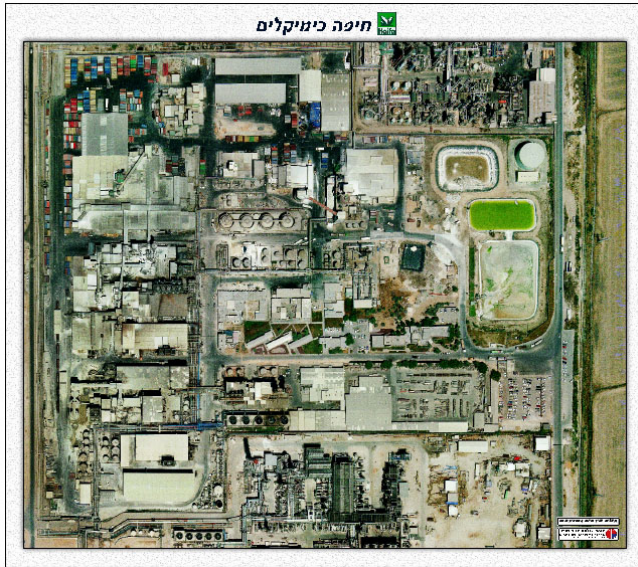


Regional map indicating the location of the N1 & N2 plants near the city of Haifa (Haifa North site)



Aerial view of Haifa Chemicals North at Haifa Bay

Pictures of the N1 & N2 plants at Haifa Bay



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

Sectoral Scope 5: Chemical Industry

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

The project activity entails a transfer of

- State-of-the art N₂O abatement technology which is not even commonly applied in Annex I countries.
- Specialised monitoring equipment
- Staff training for installation, operation and maintenance of catalyst & monitoring equipment, etc.

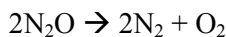
A number of N₂O abatement technologies have become available in the past 2 years after some 10 years of research, development and industrial testing. Only now that N₂O regulation is likely to be introduced in the EU by 2008³ and with the incentives provided by the Kyoto Protocol nitric acid plant operators are considering adopting these technologies. N₂O abatement technology is now commercially available from a number of catalyst manufacturers, mainly from Germany and the UK. These technologies are proprietary and will be sold or leased to nitric acid plants. The financing of this technology is facilitated by the CDM. Hence, the CDM will enable nitric acid plants in non-Annex 1 countries to become the pioneers of N₂O abatement of the global nitric acid industry.

Haifa Chemicals is determined to install a secondary abatement catalyst upon the successful registration of the N1 and N2 plants as eligible for CDM project activities.

Catalyst Technology

Haifa Chemicals has contracted with Johnson Matthey plc to install its Amoxis Hybrid® RN20/101 catalyst system that consists of a standard precious metal gauze pack with an additional base metal catalyst.

A wide range of metals (e.g. Cu, Fe, Mn, Co and Ni) have shown to be of varied effectiveness in N₂O abatement catalysts. The Amoxis® 10 – 1R abatement catalyst pellets are clover leaf shaped containing a Lanthanum-Cerium-Cobalt-Perovskite. The catalyst has been tried and tested in a number of nitric acid plants in Europe. The abatement efficiency has been shown to be 80% in the following reaction:



No contamination of the nitric acid with Cobalt or any of the other catalyst materials has been observed.

The catalyst does not require additional heat or other energy over and above the temperature that is present inside the Ammonia Oxidation Reactor anyway. There are no additional greenhouse gases or other emissions generated by the reactions on at the N₂O abatement catalyst.

Basket modifications and Heat Shield design

Most nitric acid plants have some sort of basket structure that gives structural support to the precious metal gauzes. The ammonia oxidation reaction at N1 normally operates at between 828 and 874 °C. At N2, the in burner temperature range is between 884 and 864 °C. The operational temperature increase causes the basket assembly to expand compared to when the plant is not operational (i.e. during installation of the catalyst).

This effect increases the basket diameter by 1 - 1.5%. The N1 ammonia reactor has a diameter of 635 mm; the one at N2 has a diameter of 1010 mm. Both expand by several millimetres when in operation resulting in a gap between the pelleted bed and the burners' outside walls. This resulting gap will be of



significantly lower ΔP than the pelleted bed. Hence an increase in gas flow will emerge equilibrating the ΔP throughout the system. The preferential gas flow through this gap can easily increase tenfold due to this effect.

To counter this occurrence, the baskets which support the gauze packs will have to be modified and additional heat shields will have to be installed inside the existing baskets to provide containment of the pelleted bed in a manner which prevents preferential gas flow at the perimeter.

N₂O abatement catalyst installation

The secondary catalyst itself is easily installable during a routine plant shut-down and gauze change. The pellets are poured into the support basket / heat shield arrangement and raked level. The gauze pack is then installed above this bed using the support mechanism provided by the heat shield.

Haifa Chemicals' nitric acid plant N1 operates at low pressure of 4 bar and N2 medium pressure at 7 bar inside the ammonia oxidation reactor. Through the introduction of the secondary catalyst into the ammonia reactor, a slight pressure drop (ΔP) of 25 mbar is expected to occur. This ΔP may lead to a very slight reduction in ammonia conversion efficiency and hence a very small reduction in nitric acid output. In practice, this loss of production will be insignificant.

Technology transfer and safety issues

As mentioned before, the secondary abatement technology has been tested in several industrial trials in which it has proven to be reliable in reducing N₂O and environmentally safe. Especially, its implementation does not lead to increased NO_x emissions⁴. Neither is the environment directly or indirectly harmed in any other way.

The N₂O abatement catalyst is supplied to Haifa Chemicals by Johnson Matthey on a lease basis, which requires Johnson Matthey to take back the catalyst at the end of its useful life and refine, recycle or dispose of it according to EU regulations, hence fulfilling sustainability standards.

Once installed, the catalyst itself and the AMS ought to be operated by the local Haifa Chemicals-employees. All project participants will work together on training the Haifa Chemicals workers to reliably supervise the effective operation of the catalyst technology, apply the installed monitoring system to measure the emission levels and collect the data in a manner that allows a successful completion of each verification procedure.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

The N1 Baseline will be finished by mid April 2007, hence the data collected during the baseline campaign are not available yet and therefore an N₂O emissions factor (EF_{BL}) has not been calculated and established so far. In order to approach the amount of CERs expected from N1 an EF_{BL} of 7 kg is assumed and the basis for the following CER projections. It is emphasized that the CERs from N1 can be above or below this assumed scenario.

From the data collected during the baseline campaign for N2 an N₂O emissions factor (EF_{BL}) of 7.31 kg per tonne of 100% concentrated nitric acid has been established⁵. The average production of the N1 nitric

⁴ The underlying information is commercially sensitive and will be made available to the CDM EB / the validator upon request.

⁵ Please note that the AMS uncertainty will be established under the upcoming QAL2 and is hence not deducted from this EFBL yet.



acid plant is 50,043 tonnes of 100% concentrated nitric acid per year⁶ based on the actual daily capacity of 152 tHNO₃ and 330 days of operation per year. For N2 the average annual production is 111,540 tHNO₃, based on the actual daily capacity of 338 tHNO₃ and 330 days of operation per year.

Multiplied by the EF_{BL}, the annual baseline emissions for N1 are 108,594 tCO₂e. Assuming an 85% abatement efficiency of the N₂O abatement catalyst, the project emissions for the same production output of nitric acid would be 16,289 tCO₂e. The resulting amount of emission reductions therefore would be 92,305 tCO₂e emission reductions per year.

Multiplied by the EF_{BL}, the annual baseline emissions for N2 are 252,762 tCO₂e. Assuming an 85% abatement efficiency of the N₂O abatement catalyst, the project emissions for the same production output of nitric acid would be 50,552 tCO₂e. The resulting amount of emission reductions therefore would be 214,847 tCO₂e emission reductions per year.

Based on these assumptions, the estimated emission reductions generated by the project activity over a 10 year crediting period are projected in the table below:

Years	Estimated Emission Reductions, N1 plant [tCO ₂ e]	Estimated Emission Reductions, N2 plant [tCO ₂ e]
1	92,305	214,847
2	92,305	214,847
3	92,305	214,847
4	92,305	214,847
6	92,305	214,847
7	92,305	214,847
8	92,305	214,847
9	92,305	214,847
10	92,305	214,847
Total number of crediting years	10	10
Total estimated Emission Reductions	923,050	2,148,470
Annual average over the crediting period of estimated reductions	92,305	214,847

A.4.5. Public funding of the project activity:

No public funding has been or will be received in the development, implementation or operation of this project. The complete financing of the project will be borne by the project participants.

SECTION B. Application of a baseline and monitoring methodology

⁶ All values for nitric acid production are provided in metric tonnes of 100%-concentrated nitric acid (tHNO₃), unless otherwise indicated.

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

This project is based on Approved Baseline and Monitoring methodologies AM0034 (Version 02): “Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants”.

The project draws on approved baseline methodology AM0028 (Version 4.01) for the baseline scenario selection and uses the “Tool for the demonstration and assessment of additionality” (Version 03).

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

The chosen baseline methodology AM0034 is applicable to project activities that install a secondary abatement catalyst inside the ammonia burner of a nitric acid plant, underneath the precious metal gauze pack. This corresponds with the proposed project activity.

The use of the chosen methodology is applicable as

1. The proposed project activity will be applied to an existing production facility installed prior to the 31st December 2005. The N1 plant has been commissioned and is in operation since 1967, the N2 plant since 1976. The existing nameplate production capacity for N1 is 69,350 tonnes and for N2 it is 127,750 tonnes of 100% concentrated nitric acid per year (based on 365⁷ operating days per year and a daily nameplate capacity of 190 and 350 respectively t/d tonnes of nitric acid).
2. Currently, neither plant has any N₂O destruction or abatement facility that could be affected by the project activity.
3. The project activities have no influence on the plants’ nitric acid production levels.
4. The host country has no legal requirements to reduce N₂O emissions from nitric acid plants.
5. Presently, no N₂O abatement technology is installed in both plants.
6. The project activity will not increase in NO_x emissions.
7. There is no NSCR DeNO_x -unit installed in the plant.
8. The installation of the secondary N₂O abatement catalyst will not lead to any additional direct or indirect GHG emissions within the project boundary.
9. Two complete Automated Monitoring Systems (AMS) comprised of one N₂O analyser for each plant (14 September and 26 June 2005 respectively) and a gas volume flow meter for each plant (7 and 21 November 2005) have been installed in the appropriate locations as per the methodology. The AMS has been continuously operated since its installation to collect the baseline data and will continue to measure concentration and total gas volume flow in the stack during the plant’s operation throughout the crediting period of the project activity.

B.3. Description of the sources and gases included in the project boundary

⁷ The production capacity of N2 is above nameplate capacity (111,540 tHNO₃ instead of 127,750 tHNO₃/yr). Following AM0034 (p. 11) “[...] the new capacity is considered nameplate, provided proper documentation [...] If the plant has been modified to increase production, and such de-bottleneck or expansion projects were completed before December 2005, then the new capacity is considered nameplate [...]”. Proper documentation of the underlying reasons is available and will be provided to the Validator.

materials and/or equipment expenses, or third party construction services, etc.).As per AM0034 page 11.

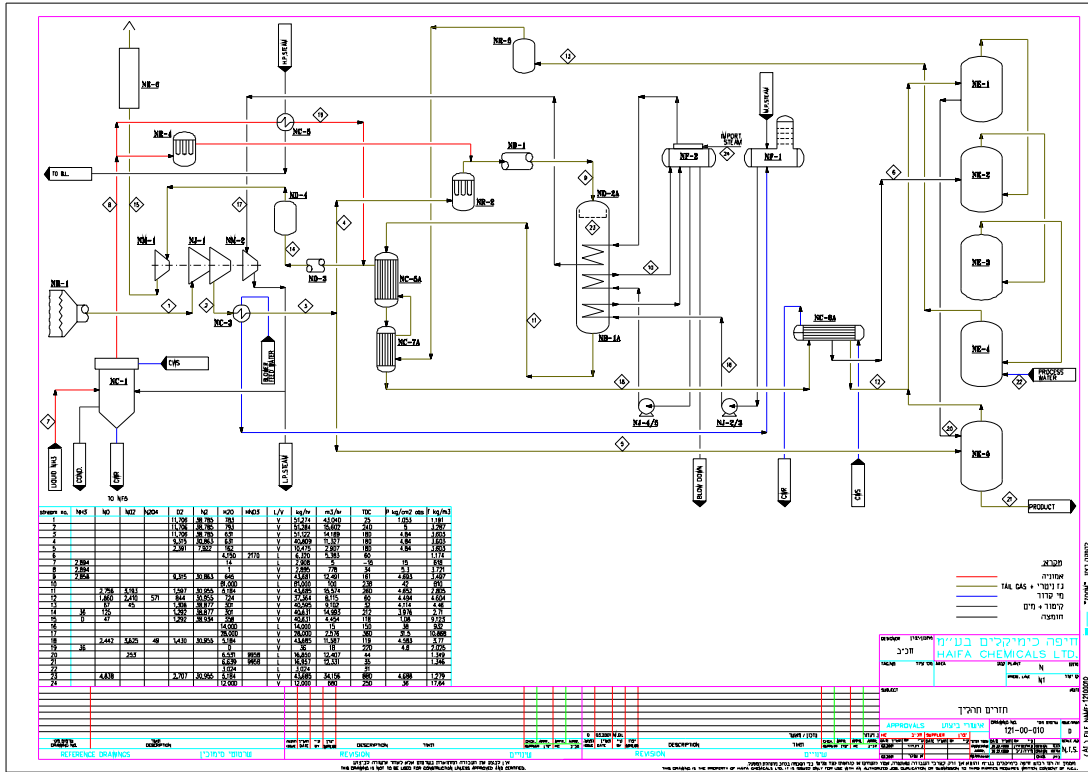


The following flow-chart displays the nitric acid plants N1 & N2 on which the project activity is to be applied. It also indicates the location, where the secondary N₂O abatement technology will be installed. The boundary of the project activity includes the complete process equipment of the N1 & N2 nitric acid plants as shown on the flow chart below⁸.

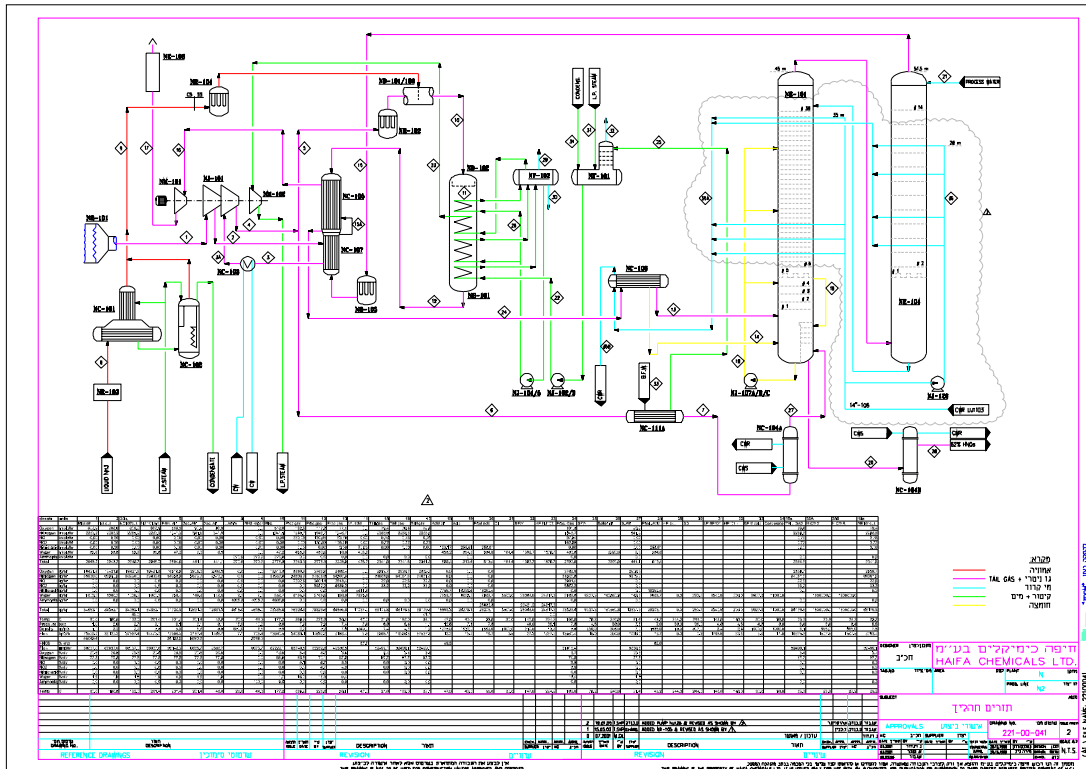
⁸ The more legible original Process Flow Chart Diagram is available on-site for the DOE at validation and can be sent to the CDM EB upon request.



Process flow chart N1 plant:



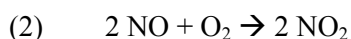
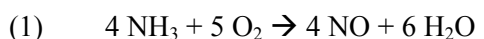
Process flow chart N2 plant:





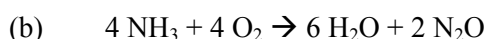
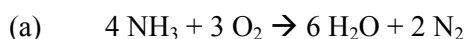
The gases relevant to the proposed project activity (and the nitric acid plant which is subject to it) originate from the ammonia oxidation process that takes place at approximately 910°C and between 4 and 7bar at the precious metal gauzes inside the plant's ammonia oxidation reactor.

The main product of this reaction is NO created by oxidising ammonia (NH₃) with atmospheric oxygen (O₂) (reaction 1). NO readily oxidises further to form NO₂ (reaction 2) and thereafter put to react with water to form a mix of nitric and nitrous acid (reaction 3). Finally, nitrous acid is also transformed into nitric acid (reaction 4), entailing an emission of NO, which is partially oxidised to NO₂ (reaction 2). These intended chemical reactions (main reactions) are the following:



The ammonia oxidation process (see reaction 1 above) yields the desired NO molecules with a 95 to 97% probability, depending on the maintenance of the accurate temperature and pressure parameters inside the ammonia burner.

However, these main reactions entail the formation of several unwanted gaseous by-products that usually are emitted into the atmosphere. The undesired by-products result from the following reactions (side reactions) that also occur in the ammonia oxidation process:



Side reaction (a) is irrelevant as it only results in the formation of water vapour and nitrogen, both present in the atmosphere in abundance. Reaction (b), however, leads to the emission of N₂O.

On leaving the ammonia oxidation reactor some of the N₂O generated may decompose

- In the high temperature homogenous gas phase inside the ammonia oxidation reactors (especially if the heat exchanger coils are inefficient or not placed directly underneath the ammonia oxidation section)
- At platinum deposits downstream of the ammonia oxidation reactors (provided that sufficient temperature levels coincide with substantial traces of platinum and the gas flow velocity allows a sufficient contact time)
- In sections of the plants downstream of the ammonia oxidation reactors, where temperatures above 300°C allow N₂O to spontaneously decompose.



An overview of all emission sources within the project boundary is provided below:

	Source	Gas	Included?	Justification / Explanation
Base-line	Nitric Acid Plant (Burner Inlet to Stack)	CO ₂	No	The process does not lead to any CO ₂ or CH ₄ emissions
		CH ₄	No	
		N ₂ O	Yes	
Project Activity	Nitric Acid Plant (Burner Inlet to Stack)	CO ₂	No	The process does not lead to any CO ₂ or CH ₄ emissions
		CH ₄	No	
		N ₂ O	Yes	
	Leakage emissions	CO ₂	No	No leakage emissions are expected.
		CH ₄	No	
		N ₂ O	No	

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The approved baseline methodology AM0034 requires the application of the procedures for baseline scenario identification as per AM0028 (in its most recent version). The following steps are taken from this methodology, adapted to the project activity in question and applied in a four-step-procedure: after the identification of all principally viable alternatives to the proposed project alternative (step 1), those that would not comply with applicable legal standards are eliminated (step 2). After conducting a barrier analysis (step 3a) the most likely “business as usual” scenario is assessed. This is the assumed baseline scenario.

As step 1 of the baseline scenario identification process will substitute the first step of the Additionality assessment (see B.5 below), the new features of the “Tool for the demonstration and assessment of additionality” (Version 03) as agreed by the CDM Executive Board and published in February 2007 (“Additionality Tool”) will be taken into account.

Step 1: Identification of all realistic, credible and technically feasible baseline scenario alternatives to the project alternative.

The AM0028-procedure suggests assessing N₂O and NO_x abatement scenarios separately. This is omitted, because NO_x abatement options are only relevant if the NO_x – regulations in Israel would require an amendment of the plant. However, Haifa Chemicals is in compliance with Israel’s NO_x regulations without any such technical amendment⁹.

The baseline scenario alternatives should include all possible options that are technically feasible to handle N₂O emissions. All scenarios that deliver outputs of comparable quality, properties and application area are to be taken into account.

Because the nitric acid production process as such remains unaffected – there are no changes in the quantity or quality of the nitric acid produced – regardless of what technology is installed in order to decrease the plant’s GHG emissions, all direct or indirect N₂O-abatement options are to be considered.

For the Haifa Chemicals N1 and N2 plants, the principally debatable options are:

⁹ The regulatory limit of 500 mg/Nm³ applicable to Haifa Chemical’s nitric acid plants is specified in the operational permit (dated 11th May 1997).



- 1) Status quo: The continuation of the current situation, without installing any N₂O abatement technology in the plant
- 2) Switch to alternative production method not involving ammonia oxidation process
- 3) Alternative use of N₂O such as:
 - a) recycling of N₂O as feedstock for the plant;
 - b) The use of N₂O for external purposes.
- 4) Installation of a Non-Selective Catalytic Reduction (NSCR) De NO_x -unit¹⁰
- 5) Installation of an N₂O abatement or reduction technology
 - a) Primary or tertiary measures to prevent the formation or reduce N₂O
 - b) A secondary facility to reduce N₂O (proposed project activity without CDM registration)

These options should also include the CDM project activity not implemented as CDM project. This is scenario alternative is included in 5 b) above.

The following options are technically not feasible:

Baseline scenario alternative 2) is not an option, because there is no other commercially viable alternative for producing nitric acid. In history, there have been other methods for producing nitric acid:

The *Birkland & Eyde* method applied electrical discharge on air to produce small quantities of NO₂ that could be reacted with water for equally small amounts of nitric acid. It was applied for industrial production in Norway between 1902 and 1930. This method did not prevail as it entails significant production costs, especially from the use of large amounts of electricity.

The same is to be said for nitric acid production according to the *Glauber* process. This was the main procedure used before now predominant Ostwald process was introduced. In entailed reacting saltpetre with sulphuric acid and required large amounts of both to match current production levels.

Even if one considered these outdated processes as viable options, amending an existent nitric acid production facility to operate using another process would not be possible. Thus, HCL could not switch to an alternative production method without building a completely new plant.

Thus, it can be assumed that a commercially viable alternative production method does not exist. Consequently, this baseline scenario alternative was regarded as technically unfeasible.

The use of N₂O as a feedstock for the production of nitric acid (scenario 3a) is technically not feasible as it is not possible to produce nitric acid from N₂O.

The use of N₂O for external purposes (scenario 3b) is technically and economically not feasible as the quantity of gas to be filtered would be enormous compared to the amount of nitrous oxide that could be recovered. The average N₂O concentration in the tail gas of Haifa Chemicals' N1 & N2 plants during the baseline campaign was determined as being clearly below 2000 ppmv, which is too low to economically recover and separate N₂O from the tail gas.

Therefore, the baseline scenarios 3) a) and b) are excluded *a priori* from further assessment.

Step 2: Elimination of all baseline scenario alternatives that are not in compliance with applicable legal or regulatory requirements.

¹⁰ NSCR: As a NSCR DeNO_x -unit would reduce N₂O emissions as a side reaction to the NO_x -reduction, a new NSCR installation can be regarded as an alternative N₂O reduction technology.



This step may also include laws and regulations that have another objective than GHG reduction, such as national or local NO_x regulations.

As stated in Step 1 above, current NO_x regulations in Israel allow for the continued operation of HCL's nitric acid plants in its current state. Also, there is no legal limit for N₂O emissions in Israel.

Also, baseline scenario alternative 5 b) would be in compliance with the NO_x standards. The secondary abatement catalysts on the market have not shown to lead to any change in the levels of NO_x emissions of the nitric acid plants where they were tested. Therefore, it can safely be assumed that Haifa Chemicals' NO_x emissions will remain constant and in compliance after the installation of the secondary catalyst. In any case, NO_x emissions are currently monitored by an NDIR analyser using extractive gas technology as installed for monitoring N₂O concentration. Therefore, any change in NO_x emission levels could easily be detected and investigated.

All of the above scenarios are in compliance with the applicable laws and regulatory requirements. Currently, there are no laws or regulations in place that would prohibit implementing any of the remaining scenario alternatives.

Therefore, this step does not lead to the exclusion of any of the aforementioned baseline scenario alternatives.

Step 3: Identification of those baseline scenario alternatives that face prohibitive barriers (step 3a) and naming of the most likely scenario alternative (step 3b).

Step 3a of the baseline identification process serves to eliminate all baseline scenario alternatives that face prohibitive barriers (investment related, technical or incompatibility with the prevailing practice).

- **Investment barriers (economic/financial)**

The installation of a Non-Selective Catalytic Reduction (NSCR) De NO_x unit would not be economically justifiable since Haifa Chemicals is already in compliance with the prevailing NO_x regulations. Should these NO_x regulations change in a way that would require Haifa Chemicals to install a NO_x abatement unit, the installation of an outdated technology (NSCR) cannot be conceived as a viable alternative to installing a state-of-the-art Selective Catalytic Reduction (SCR) DeNO_x unit. NSCR units normally require additional natural gas or Ammonia to achieve sufficient tail gas temperatures and/or the right reducing environment inside the catalyst leading to comparably high operational costs. By being led through the absorption tower the gas mix has been cooled down to a temperature level below what is required for N₂O abatement catalysts to function¹¹. Because of this, a stack-mounted catalyst abatement system would only work if the stack gas mix is re-heated. This is been done by combustion of additionally added natural gas that would have to be purchased on the open market. Therefore, baseline scenario alternative 4) faces significant investment barriers.

None of the N₂O destruction technology options (including NSCR) are expected to generate any financial or economic benefits other than CDM related income. Their operation does not create any marketable products or by-products. However, any operator willing to install and thereafter operate such technology faces significant investment and additional operating costs. The legislative and regulatory environment in Israel does not require any investment in N₂O abatement technology. Thus, any investment would be entirely voluntary.

Therefore, any baseline scenario alternatives that include the implementation of N₂O abatement catalysts will entail considerable investment barriers.

¹¹ N₂O abatement catalysts require a minimum gas mix temperature of at least 550°C in order to operate effectively; see the booklet no. 2 of the European Fertilizer Manufacturers Association (EFMA), published in the internet under <http://www.efma.org/Publications/BAT%202000/Bat02/booklet2.pdf> (page 17 therein) for further information.



- **Technical barriers**

Any of the available N₂O abatement technologies are installed in a way that they will become part of the nitric acid production plant. Primary and secondary abatement technologies are installed inside the ammonia oxidation reactor of the nitric acid plant where they may, if not correctly designed and installed, interfere with the nitric acid production process which may cause a deterioration of product quality or loss of production output. Tertiary measures require the installation of a complete catalyst container between the absorption column and the stack which may cause significant downtime of the plant during construction and commissioning.

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

- **Barriers due to prevailing practice**

The installation of N₂O abatement technology currently is neither industrial practice in Israel nor in the Middle East region.

The first installation of N₂O abatement technology in a nitric acid plant in the region is currently taking place at Abu Qir in Egypt. Also, Fertilizers & Chemicals Ltd. in Haifa as well as Haifa Chemicals itself is in the process of developing CDM project activities comprised of the installation of secondary N₂O abatement catalysts.

These projects are “first of their kind” not only in the Middle East Region but even around the world.

Step 3b shows that the identified barriers would not prevent the implementation of at least one of the alternatives (other than the proposed project activity).

Under step 3 a) it was demonstrated that those baseline scenario alternatives entailing the installation of N₂O or NO_x abatement catalysts face considerable obstacles.

The only baseline alternative that is not prevented by any one of the barriers and that is in full compliance with the prevailing laws and regulations in Israel is the status quo: The continuation of the current situation, without installing any N₂O or NO_x abatement technology in the plant. Therefore, this is identified as the applicable baseline scenario for the proposed project activity.

All other alternatives are eliminated and Step 4 (Identify the economically most attractive baseline alternative) can therefore be omitted.



The table below summarises the findings of this section B.4.:

	Baseline Scenario Alternative	Legal / Technical preclusion	Identified barriers			Probability
			Investment related	Technical	Common practice related	
1	Continued plant operation without change	No	No	No	No	Likely
2	Switch to alternative HNO ₃ production methodology	Yes	Irrelevant	Irrelevant	Irrelevant	Excluded
3 a	External use of N ₂ O	Yes (Technical)	Irrelevant	Irrelevant	Irrelevant	Excluded
3 b	N ₂ O re-cycling as feedstock for production	Yes (Technical)	Irrelevant	Irrelevant	Irrelevant	Excluded
4	Installation of a NSCR DeNO _x unit	No	Yes	Yes	Yes	Very Low
5 a/b	N ₂ O abatement catalyst not implemented as a CDM project	No	Yes	No	Yes	Very Low
6	Proposed project activity	No	No (if CER revenues \geq investment)	No	Yes	Low

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality):

This section employs the “Tool for the demonstration and assessment of additionality” (Version 03) as agreed by the CDM Executive Board and published in February 2007 (“Additionality Tool”).

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

As suggested by AM0034 (Version 02), step 1 of procedure proposed by the Additionality Tool has been omitted. The identification of scenarios alternative to the proposed project activity has been conducted within the baseline scenario identification process (see B.4. above).

Steps 2: Investment analysis



To establish additionality, the Additionality Tool requires an investment analysis, focussing on the comparison of the proposed project activity with the identified baseline scenario.

Step 2a: Choice of the appropriate investment evaluation methodology

As demonstrated above (B.4.), neither the project activity nor the identified baseline scenario generates any additional financial or economic benefits besides those obtainable from the sale of CERs. This implies the applicability of a simple cost analysis (Option I of the Additionality Tool). This evaluation method is chosen here.

Step 2b: Option I – Simple Cost Analysis

The proposed project activity will lead to significant investment and operating costs for the engineering, construction, shipping, installation and commissioning of the secondary N₂O abatement catalyst and any necessary modifications of the baskets currently holding the rashig rings. In addition, Haifa Chemicals will have to pay a regular lease fee for the continued operation and regular replacement of the secondary N₂O abatement catalyst. The investment and operating costs for the Automated Monitoring System (AMS) amount to approximately EUR 160,000 (AMS purchasing price for two complete systems, plus costs for maintenance and replacement parts, excluding any labour costs) throughout the crediting period.

The total investment and operating costs of the project activity (excluding the CDM related costs such as purchasing and operation of AMS, Validations etc.) are estimated to be approximately EUR 2.3 m over the course of the whole crediting period¹². This estimate includes the lease fee due to Johnson Matthey for the catalyst, as well as the structural changes for the basket and the operating and maintenance costs by Haifa Chemicals' staff throughout the crediting period.

The identified baseline scenario alternative – the continuation of the current situation, operating the nitric acid plant without an N₂O abatement catalyst – does not incur any additional costs. Therefore, the proposed project activity is financially and economically less attractive than the baseline scenario.

Outcome of step 2: Continue with common practice analysis

As the proposed project activity is unlikely to be financially more attractive than the identified baseline scenario alternative, the Additionality Tool requires to conduct a common practice analysis (step 4) and thus to neglect step 3.

Step 4: Common practice analysis

Step 4 has the purpose to assess the common industrial practice in the area, where the project activity is to be implemented and thus verify the results obtained in the previous steps. If the technology that is to be installed already is the common industrial practice in the region, this would be a counter-indication for the assumption that there are financially and economically more attractive alternatives and / or considerable barriers for its implementation.

Sub-step 4a: Analyse other activities similar to the proposed project activity

Market studies (e.g. by EFMA, EU IPPC, US EPA, IPCC) show that N₂O abatement technologies have not yet spread out into the nitric acid industry in Annex 1 countries, apart from occasional industrial testing. The main reason for this is a lack of regulation / incentive to reduce N₂O emissions.

The research and development work done so far have been driven by a general expectation that industrialised countries – especially the EU, USA, Japan and Canada – may eventually introduce N₂O emission

¹² More detailed, confidential information on investment and operation costs can be disclosed to the DOE and the CDM EB upon request



caps. EU legislation initiating such a limit is under way already and will probably enter into force in 2007¹³.

The installation of N₂O abatement technology currently is neither industrial practice in Israel nor anywhere else in the Middle East region. The common practice in the area is to operate such facilities without any N₂O abatement technology. However, currently all nitric acid producers in the region (e.g. in Israel and Egypt) are pursuing the implementation of secondary or tertiary N₂O abatement technologies in order to participate in the CDM. According to the Additionality Tool, other CDM project activities are not to be taken into account.

Sub-step 4b: Discuss any similar options that are occurring

Because there are no similar activities to the proposed project activity that take place in the region apart from other CDM activities (which are to be neglected), this step does not provide any additional content.

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

Conclusion

Currently, there are no national regulations or legal obligations in Israel concerning N₂O emissions. It is unlikely that any such limits on N₂O emissions will be imposed in the near future.

Haifa Chemicals is in no need to invest in any N₂O destruction or abatement technology. Neither are there any national incentives to promote similar project activities. Without the sale of the CER's generated by the project activity no revenue would be generated and the technology would not be installed. No income from any kind of potential product or by-product except CERs are able to pay back investment costs as well as running costs for the installation of the proposed project activity as no marketable product or by-product exists. The proposed CDM project activity is undoubtedly additional, since it passes all the steps of the "Tool for demonstration and assessment of additionality".

The registration of the project activity as a CDM Project and the resulting expected CER revenues are the single source of project revenues. CDM registration is therefore the decisive factor for the realization of the proposed project activity.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

1. Determination of the permitted operating conditions of the nitric acid plant to avoid overestimation of baseline emissions:

In order to avoid the possibility that the operating conditions of the nitric acid production plant are modified in such a way that increases N₂O generation during the baseline campaign, the normal ranges for operating conditions shall be determined for the following parameters: (i) oxidation temperature; (ii) oxidation pressure; (iii) ammonia gas flow rate and (iv) air input flow rates. The permitted range shall be established using the procedures described below. Note that data for these parameters is routinely logged in the process control systems of the plant.

i. Oxidation temperature and pressure:

Process parameters monitored:

OTh Oxidation temperature for each hour (°C)

OPh Oxidation pressure for each hour (Pa)

¹³ See footnote 3 for further information.



OTnormal Normal range for oxidation temperature (°C)

OPnormal Normal range for oxidation pressure (Pa)

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

Parameters monitored:

AFR Ammonia gas flow rate to the AOR (tNH₃/h)

AFRmax Maximum ammonia gas flow rate to the AOR (tNH₃/h)

AIFR_ Ammonia to air ratio (%)

AIFRmax_ Maximum ammonia to air ratio (%)

For the determination of the permitted operating conditions, the historic operating data for OT_h, OP_h, AFR and AIFR were recorded by the process control system for the previous 5 campaigns and analysed by using the hourly average values.

2. Determination of baseline emission factor: measurement procedure for N₂O concentration and gas volume flow

N₂O concentration and gas volume flow are to be monitored throughout the baseline campaign by an AMS which is to be installed and operated using European Norm 14181 (2004) as guidance where applicable. The AMS provides separate readings for N₂O concentration (NCSG) and gas volume flow (VSG) for every two seconds of operation of the plant. Error readings (e.g. downtime or malfunction) and extreme values are to be automatically eliminated from the output data series by the monitoring system.

Measurement results can be distorted before and after periods of downtime or malfunction of the monitoring system and can lead to mavericks. To eliminate such extremes and to ensure a conservative approach, the following statistical evaluation is to be applied to the complete data series of N₂O concentration as well as to the data series for gas volume flow. The statistical procedure will be applied to data obtained after eliminating data measured for periods where the plant operated outside the permitted ranges:

- Calculate the sample mean (x)
- Calculate the sample standard deviation (s)
- Calculate the 95% confidence interval (equal to 1.96 times the standard deviation)
- Eliminate all data that lie outside the 95% confidence interval
- Calculate the new sample mean from the remaining values (volume of stack gas (VSG) and N₂O concentration of stack gas (NCSG))

The average mass of N₂O emissions per hour is estimated as product of the NCSG and VSG. The N₂O emissions per campaign are estimates product of N₂O emission per hour and the total number of complete hours of operation of the campaign using the following equation:

$$BE_{BC} = VSG_{BC} * NCSG_{BC} * 10^{-9} * OH_{BC}$$

The plant specific baseline emissions factor representing the average N₂O emissions per tonne of nitric acid over one full campaign is derived by dividing the total mass of N₂O emissions by the total output of 100% concentrated nitric acid for that period. The overall uncertainty of the monitoring system shall also be determined and the measurement error will be expressed as a percentage (UNC). The N₂O emission factor per tonne of nitric acid produced in the baseline period (EF_{BL}) shall then be reduced by the estimated percentage error as follows:

$$EF_{BL} = (BE_{BC} / NAP_{BC}) (1 - UNC/100)$$

In the absence of any national or regional regulations for N₂O emissions in Israel, the resulting EF_{BL} will be used as the baseline emission factor.



The gauze supplier and gauze composition during the baseline campaign is the same as during the historic campaigns used to establish the permitted operating conditions. Therefore, the EF_{BL} derived is valid.

The plant was operating within the permitted range of normal operating conditions for more than 50% of the time, therefore the baseline campaign is valid and the resulting EF_{BL} can be applied to calculate the resulting emission reductions of the project.

Campaign Length

In order to take into account the variations in campaign length and its influence on N_2O emission levels, the historic campaign lengths and the baseline campaign length are to be determined and compared to the project campaign length. Campaign length is defined as the total number of metric tonnes of nitric acid at 100% concentration produced with one set of gauzes.

The average historic campaign length (CL_{normal}) defined as the average campaign length for the historic campaigns used to define operating condition (the previous five campaigns), will be used as a cap on the length of the baseline campaign.

If $CL_{BL} \leq CL_{normal}$, then all N_2O values measured during the baseline campaign can be used for the calculation of EF_{BL} (subject to the elimination of data that was monitored during times where the plant was operating outside of the “permitted range”).

If $CL_{BL} > CL_{normal}$, then N_2O values that were measured beyond the length of CL_{normal} during the production of the quantity of nitric acid (i.e. the final tonnes produced) are to be eliminated from the calculation of EF_{BL} .

Statistical Tests comparing Baseline Campaign with “normal” operating conditions

In accordance with AM0034, statistical tests should be performed to compare the average values of the permitted operating conditions with the average values obtained during the baseline campaign.

Since no specific statistical tests are prescribed in AM0034, the project proponents used the statistical tests that are already being used in AM0034 to ensure a consistent approach.

If the mean values for OT_h , OP_h , AFR and AIFR obtained during the baseline campaign fall within the 95% confidence interval (1.96 times the standard deviation) of the normal operating conditions, then the baseline campaign is considered to be representative of a normal campaign.

The result of these tests was that the baseline campaign is representative of a normal campaign because all four mean values obtained during the baseline campaign fall within the 95% confidence interval of the normal operating conditions.

Leakage

As per methodology AM0034, no leakage emission calculation is required since no leakage emissions are expected to occur as a result of the project activity.

Project Emissions

Over the duration of the project activity, N_2O concentration and gas volume flow in the stack of the nitric acid plant as well as the temperature and pressure of ammonia gas flow and ammonia-to-air ratio will be measured continuously.

The same statistical evaluation that was applied to the baseline data series is applied to the project data series of NCSG and VSG:

- a) Calculate the sample mean (x)
- b) Calculate the sample standard deviation (s)
- c) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation)



- d) Eliminate all data that lie outside the 95% confidence interval
 e) Calculate the new sample mean from the remaining values

$$PE_n = VSG * NCSG * 10^{-9} * OH$$

In order to take into account possible long-term emissions trends over the duration of the project activity and to take a conservative approach a moving average emission factor shall be estimated as follows:

Step 1: estimate campaign specific emissions factor for each campaign during the project's crediting period by dividing the total mass of N₂O emissions during that campaign by the total production of 100% concentrated nitric acid during that same campaign. For example, for campaign n the campaign specific emission factor would be:

$$EF_n = PE_n / NAP_n$$

Step 2: estimate a moving average emissions factor be calculated at the end of a campaign n as follows:

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

This process is repeated for each campaign such that a moving average, EF_{ma,n}, is established over time, becoming more representative and precise with each additional campaign.

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

$$\text{If } EF_{ma,n} > EF_n \text{ then } EF_p = EF_{ma,n}$$

$$\text{If } EF_{ma,n} < EF_n \text{ then } EF_p = EF_n$$

Minimum Project Emissions Factor

N₂O emissions that may result from a potential built up of platinum deposits. After the first ten campaigns of the crediting period of the project, the lowest EF_n observed during those campaigns will be adopted as a minimum (EF_{min}). EF_{min} is equal to the lowest EF_n observed during the first 10 campaigns of the project crediting period (N₂O/tHNO₃). If any of the later project campaigns results in an EF_n that is lower than EF_{min}, the calculation of the emission reductions for that particular campaign shall use EF_{min} and not EF_n.

Project Campaign Length

If the length of each individual project campaign CL_n is longer than or equal to the average historic campaign length CL_{normal} then all N₂O values measured during the baseline campaign can be used for the calculation of EF (subject to the elimination of data from the Ammonia/Air analysis, see above). If CL_n < CL_{normal}, recalculate EF_{BL} by eliminating those N₂O values that were obtained during the production of tonnes of nitric acid beyond the CL_n (i.e. the last tonnes produced) from the calculation of EF_n.

Emission Reductions

The emission reductions for the project activity over a specific campaign are determined by deducting the campaign-specific emission factor from the baseline emission factor and multiplying the result by the production output of 100% concentrated nitric acid over the campaign period and the GWP of N₂O:

$$ER = (EF_{BL} - EF_p) * NAP * GWPN_2O$$

According to AM0034, the value for Nitric acid production (NAP) during the project campaign shall not exceed the design capacity of the nitric acid plant.



The existing design production capacity for N1 is 69,350 metric tonnes and for N2 127,750 metric tonnes of 100% concentrated nitric acid per year (based on 365¹⁴ operating days per year and a daily nameplate capacity of 190 t/d 350 t/d tonnes of nitric acid). Therefore, the N1 nitric acid plant shall not be eligible to earn CERs for any tonnes of nitric acid produced exceeding 69,350 metric tonnes in any one year and the N2 nitric acid plant shall not be eligible to earn CERs for any tonnes of nitric acid produced exceeding 127,750 metric tonnes in any one year. It shall be noted however, that the “design” or “nameplate” capacity is the capacity figure that is guaranteed by the plant constructor, which is therefore conservative in nature, allowing for some safety margin for the guarantee.

In actual fact, the output capacity of the N1 nitric acid plant is 152 t/day and it normally operates for approximately 330 days per year (resulting in a factual annual production of 50,043 tHNO₃) and the output capacity of the N2 nitric acid plant is 338 t/day and it normally operates for approximately 330 days per year (resulting in a factual annual production of 111,540 tHNO₃), so it is not to be expected that both plant exceeds the design capacity for the purposes of this project.

¹⁴ As per AM0034 page 11.

**B.6.2. Data and parameters that are available at validation:**

FOR PLANT N1:

Data / Parameter:	B.1 / NCSG_{BC}
Data unit:	mg/Nm ³
Description:	N ₂ O concentration in the stack gas during the baseline campaign.
Source of data used:	NDIR N ₂ O gas analyser (ABB AO2000-Uras14)
Value applied:	For N1 [not available yet] For N2 2,376
Justification of the choice of data or description of measurement methods and procedures actually applied :	AM0034 requires the determination of the concentration of N ₂ O in the stack gas. NCSG is continuously monitored with an NDIR gas analyser ¹⁵ and monitoring results are taken and recorded for every two seconds of plant operation. Hourly means for NCSG are derived by the data acquisition system. NCSG data taken during times when the plant was operating outside the permitted operating range were eliminated. The remaining hourly average values were subjected to the following statistical analysis: <ul style="list-style-type: none"> a) Calculate the sample mean (x) b) Calculate the sample standard deviation (s) c) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation) d) Eliminate all data that lie outside the 95% confidence interval e) Calculate the new sample mean from the remaining NCSG values
Any comment:	None

Data / Parameter:	B.2 VSG_{BC}
Data unit:	Nm ³ /h
Description:	Normal gas volume flow rate of the stack gas during the baseline campaign.
Source of data used:	Gas Volume Flow meter, Emerson Rosemount Annubar® Model 3095 NFA
Value applied:	For N1 [not available yet] For N2 46,113
Justification of the choice of data or description of measurement methods and procedures actually applied :	AM0034 requires the determination of the gas volume flow (VSG) in the stack. VSG is continuously monitored with a flow meter and monitoring results are taken and recorded for every two seconds of plant operation. Hourly means for VSG are derived by the data acquisition system. VSG data taken during times when the plant was operating outside the permitted operating range were eliminated. <p>The resulting hourly average VSG values are now expressed in Nm³/h as required by AM0034 and were subsequently subjected to the following statistical analysis:</p> <ul style="list-style-type: none"> a) Calculate the sample mean (x)

¹⁵ The ABB AO2000 Uras 14 has been certified by TÜV Süddeutschland in accordance with the German 27th BImSchV (waste incineration plants, large furnaces and others). An NDIR analyser very similar to the AO2000 Uras 14 has since been certified as suitable for N₂O measurements under QAL1 of ISO14956. A QAL1 certified analyser was not available at the time of purchase by Haifa Chemicals.



	<ul style="list-style-type: none"> b) Calculate the sample standard deviation (s) c) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation) d) Eliminate all data that lie outside the 95% confidence interval e) e) Calculate the new sample mean from the remaining VSG values
Any comment:	None

Data / Parameter:	B.3 BE_{BC}
Data unit:	tN ₂ O
Description:	Total N ₂ O gas flow for baseline campaign
Source of data used:	Calculation from measured data.
Value applied:	For N1 [not available yet] For N2 169.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	<p>The total mass N₂O emissions during the baseline campaign are determined as a product of NSCG, VSG and the total hours of operation during that baseline campaign:</p> $BE_{BC} = VSG_{BC} * NCSG_{BC} * 10^{-9} * OH_{BC}$
Any comment:	None

Data / Parameter:	B.4 OH_{BC}
Data unit:	hours
Description:	Operating hours
Source of data used:	Process Control System.
Value applied:	For N1 [not available yet] For N2 1,359
Justification of the choice of data or description of measurement methods and procedures actually applied :	<p>Required by AM0034 to determine the total mass emissions of N₂O during the baseline.</p> <p>As per the operational procedures of N3, the plant is considered to be offline if the AOR temperature is below 750°C (also referred to as the “trip temperature”) as no nitric acid is produced at this temperature. Therefore, only those hours were considered operating hours if the AOR temperature was at least 750°C.</p> <p>As a result, 14 hours were excluded from the original time data series (after reduction of CL_{BL} to be the same as CL_{normal}).</p>
Any comment:	None

Data / Parameter:	B.5 NAP_{BC}
Data unit:	tHNO ₃
Description:	Metric tonnes of 100% concentrated nitric acid produced during the baseline campaign.
Source of data used:	Coriolis mass flow meter
Value applied:	For N1 [not available yet] For N2 21,864
Justification of the choice of data or de-	Required by AM0034 to calculate the average baseline emissions factor (EF _{BL}) per tonne of 100% concentrated nitric acid produced during that baseline cam-



description of measurement methods and procedures actually applied :	paign. NAP is measured with a Coriolis mass flow meter.
Any comment:	None

Data / Parameter:	B.6 TSG
Data unit:	°C
Description:	Temperature in the stack gas
Source of data used:	Stack temperature probe situated directly next to the volume flow meter.
Value applied:	Not applicable
Justification of the choice of data or description of measurement methods and procedures actually applied :	AM0034 requires the determination of gas volume flow at normal conditions in the stack. In order to calculate from the measured VSG values to VSG at normal conditions, the actual temperature in the stack is measured by temperature probes inserted directly next to the flow meter inside the stack. The resulting measurements are applied to each hourly mean VSG value for calculation of normal volume flow.
Any comment:	None

Data / Parameter:	B.7 PSG
Data unit:	bar
Description:	Pressure in the stack
Source of data used:	Stack pressure probe situated directly next to the volume flow meter.
Value applied:	Not applicable
Justification of the choice of data or description of measurement methods and procedures actually applied :	AM0034 requires the determination of gas volume flow at normal conditions in the stack. In order to calculate from the measured VSG values to VSG at normal conditions, the actual pressure in the stack has to be determined and applied to each hourly mean VSG value.
Any comment:	None

Data / Parameter:	B.8 EF_{BL}
Data unit:	tN ₂ O / tHNO ₃
Description:	Emissions factor for baseline period
Source of data used:	Calculated from measured data (tons of nitric acid produced / tons of N ₂ O emitted)
Value applied:	For N1 [not available yet] For N2 0.00731
Justification of the choice of data or description of measurement methods and procedures actually applied :	As required by AM0034 the plant specific baseline emissions factor representing the average N ₂ O emissions per tonne of nitric acid during the baseline campaign is derived by dividing the total mass of N ₂ O emissions by the total output of 100% concentrated nitric acid during the baseline campaign. The overall uncertainty of the monitoring system shall also be determined and the measurement error will be expressed as a percentage (<i>UNC</i>). The N ₂ O emission factor per tonne of nitric acid produced in the baseline period (EF _{BL}) is then reduced



	by the percentage uncertainty as follows: $EF_{BL} = (BE_{BC} / NAP_{BC}) (1 - UNC/100) (tN_2O/tHNO_3)$
Any comment:	None

Data / Parameter:	B.9 UNC
Data unit:	%
Description:	Calculated uncertainty of the overall Automated Monitoring System (AMS)
Source of data used:	Engineering reports and calculations conducted by the manufacturer of the components of the AMS.
Value applied:	For N1 5.0 For N2 5.0
Justification of the choice of data or description of measurement methods and procedures actually applied :	In accordance with AM0034 the overall measurement uncertainty of the AMS is applied in the calculation of the baseline emissions factor (EF_{BL}). <ol style="list-style-type: none"> 1. The Uras 14 ABB Analyzer accuracy is 1.0% of the range as certified by ABB on 31.01.2006 2. The compression deviation of Analyzer PI Tag (PI is the data acquisition system) is 0.1% of span 3. 3095MFA MASS PROBAR Flow meter System Accuracy is +-1% of rate (Reference Manuel 00809-0100-4809, Rev AA, August 2002). This is assumed to include DP cell and all probe uncertainties. 4. The compression deviation of Rosemount Flow meter PI Tag is 0.125% of span 5. Analogue input DCS Foxboro card (FBM01 ANALOG INPUT MODULE) accuracy is +-0.05% of span <p>These values were used to calculate the overall uncertainty of the AMS by taking the square root of the sum of the squares of these values.</p>
Any comment:	None.

Data / Parameter:	B.10 AFR
Data unit:	tNH ₃ /h
Description:	Mean Ammonia gas flow rate to the ammonia oxidation reactor
Source of data used:	Coriolis mass flow meter
Value applied:	Not applicable, monitored data of AFR will be used to determine if plant was operating outside of AFR_{max} .
Justification of the choice of data or description of measurement methods and procedures actually applied :	The monitoring of AFR is required by AM0034 in order to determine AFR_{max} .
Any comment:	None

Data / Parameter:	B.11 AFR_{max}
Data unit:	tNH ₃ /h



Description:	Maximum Ammonia gas flow rate to the ammonia oxidation reactor
Source of data used:	AFR data from previous campaigns
Value applied:	For N1 [not available yet] For N2 6,113
Justification of the choice of data or description of measurement methods and procedures actually applied :	AFR _{max} is used to determine those periods where the plant may be operating outside of the permitted operating conditions. The AFR data from the historic campaigns was used, after the exclusion of the upper and lower 2.5% percentiles.
Any comment:	None

Data / Parameter:	B.12 AIFR
Data unit:	% v/v
Description:	Mean Ammonia to air ratio into the ammonia oxidation reactor
Source of data used:	Measurements of AFR and primary air flow rates
Value applied:	Not applicable, monitored data of AIFR will be used to determine if plant was operating outside of AIFR _{max}
Justification of the choice of data or description of measurement methods and procedures actually applied :	The monitoring of AIFR is required by AM0034 in order to determine AIFR _{max} . The permitted range for the NH ₃ to Air ratio is taken from the data of the historic campaigns. Primary Air flow is measured with a venturi dP flow meter.
Any comment:	None

Data / Parameter:	B.15 AIFR_{max}
Data unit:	% v/v
Description:	Maximum Ammonia to air ratio into the ammonia oxidation reactor during the baseline campaign.
Source of data used:	AIFR
Value applied:	For N1 [not available yet] For N2 9.22
Justification of the choice of data or description of measurement methods and procedures actually applied :	In accordance with AM0034 AIFR _{max} is used to determine those periods where the plant may be operating outside of the permitted operating conditions. AIFR _{max} is derived from the maximum value observed from the data series of AIFR, which in the case of N1 was [not available yet] and N2 was 9.22.
Any comment:	None

Data / Parameter:	B.13 CL_{BL}
Data unit:	tHNO ₃
Description:	Length of the baseline campaign measured in metric tonnes of 100% concentrated nitric acid produced during that baseline campaign.



Source of data used:	NAP _{BC}
Value applied:	For N1 [not available yet] For N2 113,748
Justification of the choice of data or description of measurement methods and procedures actually applied :	<p>CL_{BL} is comprised of each and every tonne of nitric acid produced during the baseline campaign, regardless of whether the measured NCSG and VSG data were excluded from the relevant period.</p> <p>CL_{BL} is then compared with CL_{normal}. The actual total number of tonnes of nitric acid produced during CL_{BL} was 17,570.99 which is 269.29 tonnes of nitric acid ‘longer’ than CL_{normal}, therefore, the time data series of CL_{BL} was cut by the last few hours of measurements until the NAP value for CL_{BL} was below CL_{normal}. Since only NAP measurements for full hours are available, the CL_{BL} was shortened to 17,256.75 tonnes of nitric acid instead of the exact 17,301.7 tonnes given by CL_{normal}.</p>
Any comment:	None

Data / Parameter:	B.14 CL_{normal}
Data unit:	tHNO ₃
Description:	Average length of the historic campaigns measured in metric tonnes of 100% concentrated nitric acid produced during that baseline campaign.
Source of data used:	Mass Balance calculations and flow meter measurements as described in NAP.
Value applied:	For N1 [not available yet] For N2 [not available yet]
Justification of the choice of data or description of measurement methods and procedures actually applied :	<p>In accordance with AM0034 the average historic campaign length (CL_{normal}) is defined as the average campaign length for the historic campaigns that were used to define operating condition. CL_{normal} presents the cap on the length of the baseline campaign from which the baseline emissions factor will be derived.</p> <p>The baseline campaign length (CL_{BL}) has to be compared to the established average historic campaign length (CL_{normal}) and if it is found that</p> <ul style="list-style-type: none"> - CL_{BL} ≤ CL_{normal}, then all N₂O values measured during the baseline campaign can be used for the calculation of EF_{BL} (subject to the elimination of data that was monitored during times where the plant was operating outside of the “permitted range”). - CL_{BL} > CL_{normal}, then N₂O values that were measured beyond the length of CL_{normal} during the production of the quantity of nitric acid (i.e. the final tonnes produced) are to be eliminated from the calculation of EF_{BL}. <p>During the five historic campaigns, a total of [not available yet] metric tonnes of 100% concentrated nitric acid have been produced, resulting in an average production output (NAP) of [not available yet] per campaign. This value represents the average historic campaign length (CL_{normal}).</p>
Any comment:	None.

Data / Parameter:	B.16 OT_h
Data unit:	°C
Description:	Oxidation temperature for each hour during the baseline campaign



Source of data used:	Monitoring results of three thermocouples inside the ammonia oxidation reactor and recorded by the data acquisition system.
Value applied:	Not applicable
Justification of the choice of data or description of measurement methods and procedures actually applied :	In accordance with AM0034 the oxidation temperature in the ammonia oxidation reactor (OTh) has to be monitored and compared to the Normal range for oxidation temperature (OT_{normal}). VSG and NCSG data obtained during times when OTh was above or below OT_{normal} has to be eliminated from the calculation of EF_{BL} .
Any comment:	None

Data / Parameter:	B.17 OT_{normal}
Data unit:	°C (min and max)
Description:	Normal range operating temperature
Source of data used:	Measurements from thermocouples during historical campaigns
Value applied:	For N1 828°C (min.) and 874°C (max.) For N2 864°C (min.) and 884°C (max.)
Justification of the choice of data or description of measurement methods and procedures actually applied :	AM0034 requires the establishment of the normal range of operating temperatures in the ammonia oxidation reactor (AOR). Measurements are taken continuously by a thermocouple inside the AOR, all data taken during the 5 historic campaigns have been interpreted as a sample of a stochastic variable. All data falling within the upper and lower 2.5% percentile have been eliminated, the range of the remaining values represents the maximum and minimum normal operating temperatures in the AOR.
Any comment:	None

Data / Parameter:	B.18 OP_h
Data unit:	bar
Description:	Oxidation Pressure for each hour during the baseline campaign
Source of data used:	Discharge of the air compressor before the ammonia to air mixer.
Value applied:	Not applicable.
Justification of the choice of data or description of measurement methods and procedures actually applied :	In accordance with AM0034 the oxidation pressure in the ammonia oxidation reactor (OPh) has to be monitored and compared to the Normal range for oxidation temperature (OP_{normal}). VSG and NCSG data obtained during times when OPh was above or below OP_{normal} has to be eliminated from the calculation of EF_{BL} . AM0034 prescribes the monitoring and recording of the Oxidation Pressure for each hour (OPh) during the baseline campaign. This would imply the measurement of pressure inside the Ammonia Oxidation Reactor. In the case of N3, the pressure probe is located at the discharge of the air compressor before the ammonia to air mixer. Since the location of this probe remains the same during the historic campaigns, the baseline campaigns and the project campaigns, it is appropriate to use this value for comparison of OPh between these campaigns.
Any comment:	None



Data / Parameter:	B.19 OP_{normal}
Data unit:	bar (min and max)
Description:	Normal operating pressure of the ammonia oxidation reactor as observed during the historic campaigns.
Source of data used:	Discharge of the air compressor before the ammonia to air mixer.
Value applied:	For N1 [not available yet] bar For N2 6.2 bar to 7.0 bar
Justification of the choice of data or description of measurement methods and procedures actually applied :	AM0034 requires the establishment of the normal range of operating pressure in the ammonia oxidation reactor. All data taken during the 5 historic campaigns have been interpreted as a sample of a stochastic variable. All data falling within the upper and lower 2.5% percentile have been eliminated; the range of the remaining values represents the maximum and minimum normal operating pressure.
Any comment:	None

Data / Parameter:	B.20 GS_{normal}
Data unit:	Name of Supplier
Description:	Gauze supplier for the operating condition campaigns
Source of data used:	Monitored / Invoices
Value applied:	For N1 [not available yet] For N2 [not available yet]
Justification of the choice of data or description of measurement methods and procedures actually applied :	AM0034 requires the monitoring of the supplier of the ammonia oxidation catalyst gauze. The recorded information is not further processed in the methodology but it is used as a plausibility check against the information for GC. Haifa Chemicals has been using ammonia oxidation catalyst gauzes supplied by Heraeus for the past several years in N1 and N1 while gauzes supplied by Johnson Matthey were used in N1 and N2. This strategy is applied by many nitric acid producers in order to avoid being reliant on only one gauze supplier. However, by deciding on using the N ₂ O abatement catalyst supplied by Johnson Matthey in all four nitric acid plants, Haifa Chemicals also made the decision to switch to using Johnson Matthey ammonia oxidation catalyst gauzes in all four plants as part of the Amoxis Hybrid [®] RN20/101 catalyst system. Therefore, the GS _{project} will be Johnson Matthey plc for the foreseeable future. The value for GS _{normal} is only a plausibility check, the decisive value in determining if the baseline campaign data is applicable is the comparison of GC _{normal} and GC _{BL} .
Any comment:	None

Data / Parameter:	B.21 GS_{BL}
Data unit:	Name of Supplier
Description:	Gauze supplier for the operating condition campaigns
Source of data used:	Monitored / Invoices
Value applied:	For N1 [not available yet]



	For N2 [not available yet]
Justification of the choice of data or description of measurement methods and procedures actually applied :	AM0034 requires the monitoring of the supplier of the ammonia oxidation catalyst gauze. The recorded information is not further processed in the methodology but it is used as a plausibility check against the information for GC.
Any comment:	None

Data / Parameter:	B.23 GC_{normal}
Data unit:	%
Description:	Gauze composition during the 5 historic operating campaigns expressed as percentage by weight of the precious metals Platinum, Rhodium and, if applicable, Palladium comprising the Ammonia Oxidation Catalyst gauzes.
Source of data used:	Monitored / Gauze supplier invoices
Value applied:	Platinum (Pt) 95.0% Rhodium (Rh) 5.0% Palladium (Pd) 0.0%
Justification of the choice of data or description of measurement methods and procedures actually applied :	In accordance with AM0034, if the composition of the ammonia oxidation catalyst used for the baseline campaign and after the implementation of the project are identical to that used in the campaign for setting the operating conditions (previous five campaigns), then there shall be no limitations on N ₂ O baseline emissions.
Any comment:	None

Data / Parameter:	B.24 GC_{BL}
Data unit:	%
Description:	Gauze composition during the baseline campaign expressed as percentage by weight of the precious metals Platinum, Rhodium and, if applicable, Palladium comprising the Ammonia Oxidation Catalyst gauzes.
Source of data used:	Monitored / Gauze supplier invoices
Value applied:	Platinum (Pt) 95.0% Rhodium (Rh) 5.0% Palladium (Pd) 0.0%
Justification of the choice of data or description of measurement methods and procedures actually applied :	<p>A change in the composition of the ammonia oxidation catalyst in the baseline campaign to a composition other than that used in the previous five campaigns, is permissible without any limitation on the N₂O baseline emissions if the following conditions are met</p> <ol style="list-style-type: none"> The baseline catalyst composition is considered as common practice in the industry, or The change in catalyst composition is justified by its availability, performance, relevant literature etc. <p>Otherwise, the baseline emission factor shall be set to the conservative IPCC default emission factor for N₂O from nitric acid plants which have not installed N₂O destruction measures (4.5 kg-N₂O / t HNO₃).</p> <p>GC_{BL} at Haifa Chemicals' N1 nitric acid plant is the same as GC_{normal}, therefore,</p>



	the results of the baseline campaign are fully valid and applicable.
Any comment:	None

Data / Parameter:	B.26 EF_{reg}
Data unit:	tN ₂ O/tHNO ₃
Description:	Emissions cap for N ₂ O from nitric acid production set by government regulation
Source of data used:	Ministry of Environment
Value applied:	None
Justification of the choice of data or description of measurement methods and procedures actually applied :	There is currently no regulation in Israel that limits the emissions of N ₂ O from nitric acid production.
Any comment:	None.

B.6.3 Ex-ante calculation of emission reductions:

Description of the N.serve Database Management System (N.DBMS)

All data necessary for the monitoring and verification procedures related to the project activity are transferred from the nitric acid plants N1 & N2 data acquisition systems into the according dedicated relational database management systems (“N.DBMS”) based on Microsoft Access 2002. Database management systems are designed for a structured storage of large amounts of data providing for minimum redundancy and maximum flexibility to allow best practice data analysis. Relation DBMS organize all data in tables. N.DBMS mainly consists of three such tables, labelled PROJECTS, CAMPAIGNS, and DATA_CROSS.

The first table, PROJECTS, serves as an anchor for all data stored. Each CDM project must be defined here, before any related data can be stored. Table PROJECTS provides a unique identifier and a short name for each project. In addition, project specific data such as owner and location may be stored.

Structure of table PROJECTS

Field Name	Field Type	Comment
ProjId	Integer	<i>Unique identifier for the project</i>
ProjName	Text	<i>Short name of the project</i>
ProjOwner	Text	<i>Operator of the installation</i>
ProjLoc	Text	<i>Location of the installation (City)</i>
ProjCountry	Text	<i>Location of the installation (Country)</i>

Sample content of table PROJECTS

Projects				
ProjId	ProjName	ProjOwner	Proj-Loc	ProjCountry
2	N1	Haifa Chemicals	Haifa	Israel
3	N2	Haifa Chemicals	Haifa	Israel
4	N3	Haifa Chemicals	Haifa	Israel
5	N4	Haifa Chemicals	Haifa	Israel

Table CAMPAIGNS defines the individual production campaigns and contains data which describe the campaign as a whole, such as date and time of start and stop and the physical units in which the data are stored. Each campaign must be defined here, before time series of related data can be stored.

Structure of table CAMPAIGNS

FieldName	FieldType	Comment
ProjId	Integer	Identifier of the project, to which the campaign belongs
CampId	Integer	Identifier of the campaign
CampName	Text	Campaign name defined by owner
CampType	Text	Type of campaign: H (historical), B (baseline), I (Intermediate, between BL and CDM registration), P (Project)
DateStart	Date	Starting day of the campaign
TimeStart	Date	Starting time of the campaign
DateStop	Date	Stopping day of the campaign
TimeStop	Date	Stopping time of the campaign
Period	Text	Length of measurement period: hours, minutes, seconds
CampLength	Number	Length of campaign (measured in tons of nitric acid produced)
AFR_Unit	Text	Physical unit of AFR data
AIFR_Unit	Text	Physical unit of AIFR data
NAP_Unit	Text	Physical unit of NAP data
NCSG_Unit	Text	Physical unit of NCSG data
Oph_Unit	Text	Physical unit of OPh data
OTh_Unit	Text	Physical unit of OTh data
VSG_Unit	Text	Physical unit of VSG data

Finally, the times series of the parameter values listed above are stored in table DATA_CROSS. Each set of values for the different parameters is identified by the ProjId, CampId and a date/time-stamp.

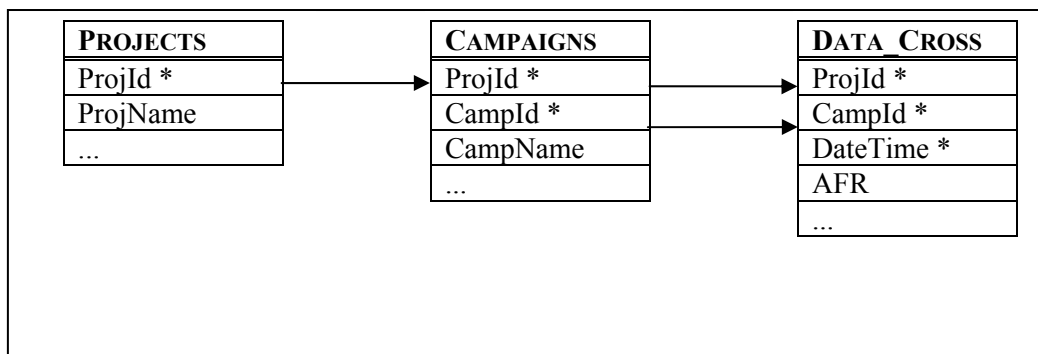


Structure of table DATA_CROSS

FieldName	FieldType	Comment
ProjId	Integer	Identifier of the project, to which the campaign belongs
CampId	Integer	Identifier of the campaign to which the data belong
DateTime	Date	Date and time stamp
AFR	Number	AFR value
AIFR	Number	AIFR value
NAP	Number	NAP value
NCSG	Number	NCSG value
Oph	Number	Oph value
OTh	Number	OTh value
VSG	Number	VSG value

The tables PROJECTS, CAMPAIGNS, and DATA_CROSS are linked by so-called 1:n relationships. That is, for each project, there may be n campaigns and for each campaign, m sets of data may be stored, where n and m indicated the number of campaign and data sets, respectively. Other than in Excel, there is no practical limit (other than disk space and computer performance) for n and m when using a DBMS such as Access.

Data model



Stars (*) indicate the primary keys of the three tables, which make sure, that data sets are unique.

Using the database structure outlined above, it is now possible to analyse the data stored in many different ways using the database query mechanisms provided by Access. All statistical analyses and exclusions of parameter sets required by AM0034 will be carried out by appropriately designed database queries, which will be described in detail below.

Calibration using historical campaigns and calculation of the baseline emissions factor with N.DBMS

In a first step, a number of statistical calculations are carried out for the historical and baseline data using Query 1¹⁶:

- Number of data sets
- Minimum value
- Maximum value

¹⁶ All queries are available and can be provided to the DOE upon request.



- Mean value and/or sum (depending on the character of the parameter)
- Standard deviation
- 95% confidence interval

The resulting table, which is in part shown below, is exported into an Excel spreadsheet for further analysis¹⁷.

Table: Resulting Access table of Query 1 for N2

ProjId	CampType	Count(DT)	Count(AFR)	Min(AFR)	Max(AFR)	Avg(AFR)	StdDev(AFR)	Count(AIFR)
3 B		1,776.00	1,770.00	-7.42	6,737.89	3,696.75	1,354.55	1,776.00
3 H		9,217.00	9,169.00	-69.95	6,238.95	3,663.43	1,228.33	9,208.00

The table shown above is reorganised into the sheet shown below to enhance clarity and convenience. The table below shows the unfiltered results for Historic and Baseline data without any parameter limits.

Table: N2 plant, Historical campaign, after Query 1 in Excel format (without any parameter limits)

N.DBMS Baseline Calculation		Project: Haifa Chemicals N2, Haifa, Israel								
Historical campaigns		Query 1: Without parameter limits								
Parameter	OH	AFR	AIFR	Oph	OTh	NCSG	VSG	NAP		
Unit	h	kg NH3 / h	1	bar-g	oC	ppm	mg N2O / Nm3	Nm3 / h	t HNO3	
Count	9,217	9,169	9,208	9,217	9,217					
Minimum		-70	0.00	0.00	0					
Maximum		6,239	100.00	7.10	890					
Mean		3,663	15.48	6.06	800					
Standard deviation		1,228	23.56	1.94	228					
95% confidence level (1.96 * Std.dev.)		2,408	46.17	3.81	448					
Sum									113,748	

Next, the 2.5% percentiles for OTh and OPh are excluded from the Historic campaigns (exclusion of unreasonable data) to determine the normal operating range for these parameters. The results are applied to the data set and the results are shown in Historic Query 2.

¹⁷ Results can only be shown for N2 as the Baseline campaign for N1 was not finished at the point in time of submission of the PDD.

**Table: N2 plant, Historical campaign, after Query 2 - Exclusion of 2.5% percentiles for Oth and Oph from historical data**

N.DBMS Baseline Calculation		Project: Haifa Chemicals N2, Haifa, Israel								
Historical campaigns		Query 2: With limits on historical data								
Parameter	OH	AFR	AIFR	Oph	OTh	NCSG	NCSG	VSG	NAP	
Unit	h	kg NH3 / h	1	bar-g	oC	ppm	mg N2O / Nm3	Nm3 / h	t HNO3	
Count	8,278	8,278	8,278	8,278	8,278	8,278				
Remaining share of data sets	90%	90%	90%	90%	90%					
Minimum		1,445	7.73	6.01	839					
Maximum		6,239	15.35	7.10	890					
Mean		4,046	9.01	6.69	875					
Standard deviation		370	0.13	0.23	5					
95% confidence level ($1.96 * Std.dev.$)		725	0.26	0.45	10					
Sum									109,952	
<i>Limits acc. to consistency check</i>		not blank	not blank	not blank	not blank					
Lower limit		0	0	6	800					
Upper limit										

This Excel sheet is now used to conduct a manual plausibility check. In case if the data series shows negative or obviously invalid values. Such values would be excluded at this stage.

Next, the analysis of the baseline data can be conducted applying the results of the analysis of the historical data.

Table: N2 plant, Baseline campaign, after Query 1 - determination of OH and NAP

N.DBMS Baseline Calculation		Project: Haifa Chemicals N2, Haifa, Israel								
Baseline campaign		Query 1: Without parameter limits								
Parameter	OH	AFR	AIFR	Oph	OTh	NCSG	NCSG	VSG	NAP	
Unit	h	kg NH3 / h	1	bar-g	oC	ppm	mg N2O / Nm3	Nm3 / h	t HNO3	
Count	1,776	1,770	1,776	1,776	1,776	1,776		1,776	0	
Minimum		-7	0.00	0.00	19	1	2	-24		
Maximum		6,738	100.00	7.14	887	1,571	3,086	51,396		
Mean		3,697	9.27	5.88	776	1,080	2,122	40,789		
Standard deviation		1,355	8.75	2.22	265	357	701	15,635		
Sum	1,776								22,116	
Baseline emissions	BE	$= VSG * NCSG * Oh$							t N2O	153.7
Emission factor	EF	$= BE / NAP$							kg N2O / t HNO3	6.95

According to this Query 1, the OH value of the baseline campaign is 1,776 hours and the NAP value is 22,116 tonnes of nitric acid.

Query 2 to 5: Applying the normal operating range from historical data

After conducting Queries 2 to 5 which effect the elimination of

- 1) all invalid (i.e. obviously inconsistent) historic data sets
- 2) all historic data sets outside the 95% confidence intervals as prescribed by AM0034
- 3) all baseline data sets registered while the plant was operating outside the historic operational parameters
- 4) and all baseline data sets that were recorded for HNO₃-production beyond the established CL_{normal}-value

77% of all original data sets remain.



The remaining data sets are those recorded when the plant was operating normal. Data sets registered during start-up or shut-down of the plant are not taken into account.

Table: N2 plant, Baseline campaign, after Query 5 – 2.5% percentile analysis and other steps to achieve remaining data set for when plant was operating normal

N.DBMS Baseline Calculation		Project: Haifa Chemicals N2, Haifa, Israel								
Baseline campaign		Query 5: Permitted range from hist. campaigns applied to BL data, invalid data sets excluded, CL cut								
Parameter	OH	AFR	AIFR	Oph	OTh	NCSG	NCSG	VSG	NAP	
Unit	h	kg NH3 / h	1	bar-g	oC	ppm		Nm3 / h	t HNO3	
Count	1,381	1,381	1,381	1,381	1,381	1,381		1,381		
Remaining share of data sets	78%	78%	78%	78%	78%	78%		78%		
Minimum		21	8.66	6.2	865	16	32	40,305		
Maximum		6,113	9.22	7.0	884	1,440	2,830	50,902		
Mean		4,063	9.05	6.7	876	1,199	2,356	46,145		
Standard deviation		371	0.07	0.2	4	85	168	3,526		
95% confidence level (1.96 * Std.dev.)		727	0	0.5	7	167	328	6,910		
Sum	1,547								21,864	
<i>Limits acc. to consistency check</i>		not blank		not blank	not blank	not blank				
Lower limit			0	6.16	864					
Upper limit		6,239	15.4	6.99	884					
	(see Q2-B)									
Baseline emissions	BE	= VSG * NCSG * Oh							t N2O	168.2
Emission factor	EF	= BE / NAP							kg N2O / t HNO3	7.69

The 95% confidence level of NCSG and VSG values is derived, thereby excluding outliers and determining the mean values that are to be applied to the calculation of BE. The UNC-value applied here of 5% is provisional only, because the QAL2 test report has not yet been completed.

Table: N2 plant, Baseline campaign, Query 6 - Application of 95% confidence interval and calculation of EF_{BL}

N.DBMS Baseline Calculation		Project: Haifa Chemicals N2, Haifa, Israel								
Baseline campaign		Query 6: Q5 + confidence levels applied to baseline data								
Parameter	OH	AFR	AIFR	Oph	OTh	NCSG	NCSG	VSG	NAP	
Unit	h	kg NH3 / h	1	bar-g	oC	ppm	mg N2O / Nm3	Nm3 / h	t HNO3	
Count	1,359	1,359	1,359	1,359	1,359	1,359		1,359		
Remaining share of data sets	77%	77%	77%	77%	77%	77%		77%		
Minimum		21	8.66	6.2	865	1,058	2,078	40,305		
Maximum		6,113	9.22	7.0	884	1,361	2,673	50,902		
Mean		4,061	9.05	6.7	876	1,200	2,357	46,113		
Standard deviation		372	0.06	0	4	67	131	3,524		
95% confidence level (1.96 * Std.dev.)										
Sum	1,547								21,864	
<i>Limits acc. to consistency check</i>		not blank		not blank	not blank	not blank		not blank		
Lower limit				6.16	864	1,032		39,235		
Upper limit		6,239	15.4	6.99	884	1,366		53,056		
	(see Q2-B)									
Baseline emissions	BE	= VSG * NCSG * Oh							t N2O	168.2
Emission factor	EF	= BE / NAP * (1 - UNC/100)							kg N2O / t HNO3	7.31
Uncertainty	UNC									5

For the N2 plant the resulting baseline emissions factor is 7.31 kgN₂O/tHNO₃. It is based on a 77% remaining share of all data sets.

During the EF_p and ER_n calculation, the same procedures will be applied in the N.DBMS as described in this section in accordance with AM0034.

Ex-ante calculation of Emission Reductions



Several of the parameters necessary to calculate the emission reductions expected from the project activity will only be established during the operation of the project.

Therefore, certain assumptions had to be made for the calculations (see section A.4.4 above for details):

- Production output of nitric acid (NAP) per year for N1 and N2 being 161,584 tonnes of nitric acid
- Emissions Factor during each of the project campaigns (EF_P) which is mainly influenced by the abatement efficiency of the N_2O abatement catalyst, which is assumed to be at least 85% of baseline N_2O emissions. Taking the assumed EF_{BL} of 7 kg N_2O /t HNO_3 for N1 and the calculated 7.31 kg N_2O /t HNO_3 for N2 and applying 85% abatement efficiency, the annual baseline emissions would be 361,356 t CO_2E and the annual emission reductions 307,152 t CO_2E .
- Project start on July 2007.

These values are applied in the calculations for table B.6.4 below.

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tonnes of CO ₂ e)	Estimation of baseline emissions (tonnes of CO ₂ e)	Estimation of leakage (tonnes of CO ₂ e)	Estimation of overall emission reductions (tonnes of CO ₂ e)
2007	27,102	180,678	13,551	153,576
2008	54,203	361,356	27,102	307,152
2009	54,203	361,356	27,102	307,152
2010	54,203	361,356	27,102	307,152
2011	54,203	361,356	27,102	307,152
2012	54,203	361,356	27,102	307,152
2013	54,203	361,356	27,102	307,152
2014	54,203	361,356	27,102	307,152
2015	54,203	361,356	27,102	307,152
2016	54,203	361,356	27,102	307,152
2017	54,203	361,356	27,102	307,152
Total	569,132	3,794,238	284,571	3,225,096

**B.7 Application of the monitoring methodology and description of the monitoring plan:****B.7.1 Data and parameters monitored:**

All of the monitoring equipment used to derive the data for this PDD has been made part of the ISO 9001/14001 procedures. Also, Annual Surveillance Tests (AST) will be conducted by an ISO 17025 accredited company once per year to ensure continuous accuracy standards of the measurements taken by the AMS installed.

All of the data obtained and used as part of the baseline and during the crediting period of the project will be archived electronically for at least 2 years in at least 2 different locations.

Data / Parameter:	P.1 NCSG
Data unit:	ppmv (convertible to mg N ₂ O / m ³)
Description:	N ₂ O concentration in the stack gas during each project campaign.
Source of data to be used:	NDIR N ₂ O gas analyser (ABB AO2000 Uras-14)
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not available yet.
Description of measurement methods and procedures to be applied:	AM0034 requires the determination of the concentration of N ₂ O in the stack gas. NCSG is continuously monitored with an NDIR gas analyser ¹⁸ and monitoring results are taken and recorded for every two seconds of plant operation. Hourly means for NCSG are derived by the data acquisition system. NCSG data taken during times when the plant was operating outside the permitted operating range were eliminated. The remaining hourly average values were subjected to the following statistical analysis: a) Calculate the sample mean (x) b) Calculate the sample standard deviation (s) c) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation) d) Eliminate all data that lie outside the 95% confidence interval e) Calculate the new sample mean from the remaining NCSG values
QA/QC procedures to be applied:	Automatic zero and span calibrations are carried out by the analyser automatically at least once per day. See Monitoring Plan for more details.
Any comment:	None

Data / Parameter:	P.2 VSG
Data unit:	Nm ³ /h
Description:	Normal gas volume flow rate of the stack gas during each project campaign.
Source of data to be	Gas Volume Flow meter, Emerson Rosemount Annubar® Model 3095 NFA

¹⁸ The Environnement S.A. MIR 9000 gas analyser has been certified according to ISO 14956, QAL1 procedures as suitable for stack gas concentration monitoring of NO, NO₂, SO₂ and various other gasses. At the time of installation of the AMS at Haifa Chemicals's N1 plant, no analyser was available on the market that had already passed the certification for N₂O.



used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not available yet.
Description of measurement methods and procedures to be applied:	<p>AM0034 requires the determination of the gas volume flow (VSG) in the stack. VSG is continuously monitored with a flow meter and monitoring results are taken and recorded for every two seconds of plant operation. Hourly means for VSG are derived by the data acquisition system. Temperature and pressure is also continuously measured in the stack and the VSG values subsequently adjusted to derive the VSG at normal conditions (i.e. standard pressure and temperature).</p> <p>VSG data taken during times when the plant was operating outside the permitted operating range are to be eliminated.</p> <p>The resulting hourly average VSG values are now expressed in Nm³/h as required by AM0034 and where subsequently subjected to the following statistical analysis:</p> <ol style="list-style-type: none"> Calculate the sample mean (x) Calculate the sample standard deviation (s) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation) Eliminate all data that lie outside the 95% confidence interval Calculate the new sample mean from the remaining VSG values
QA/QC procedures to be applied:	The flow meter is calibrated at least annually. See Monitoring Plan for more details.
Any comment:	None.

Data / Parameter:	P.3 PE_n
Data unit:	tN ₂ O
Description:	Total mass N ₂ O emissions in each project campaign.
Source of data to be used:	Calculated from the measurements from measured data.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not available yet.
Description of measurement methods and procedures to be applied:	<p>Not applicable, calculated value as per the following formula:</p> $PE_n = VSG * NCSG * 10^{-9} * OH$
QA/QC procedures to be applied:	Not applicable. Calculated value.
Any comment:	None.

Data / Parameter:	P.4 OH_n
Data unit:	hours



Description:	Total operating hours during each project campaign
Source of data to be used:	Process Control System.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not available yet.
Description of measurement methods and procedures to be applied:	Required by AM0034 to determine the total mass emissions of N ₂ O during the baseline. During the project, the “trip temperature” of 750°C will be applied as the exclusion criterion for determining those hours during which the plant was offline during a campaign.
QA/QC procedures to be applied:	Subject to ISO 9001/14001 procedures.
Any comment:	None.

Data / Parameter:	P.5 NAP
Data unit:	tHNO ₃
Description:	Metric tonnes of 100% concentrated nitric acid during each project campaign.
Source of data to be used:	Coriolis mass flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not available yet.
Description of measurement methods and procedures to be applied:	Required by AM0034 to calculate the average baseline emissions factor (EF _{BL}) per tonne of 100% concentrated nitric acid produced during that baseline campaign. NAP is measured with a Coriolis mass flow meter.
QA/QC procedures to be applied:	ISO9001/14001 procedures and documented in the applicable ISO handbooks.
Any comment:	

Data / Parameter:	P.6 TSG
Data unit:	°C
Description:	Temperature in the stack gas
Source of data to be used:	Stack temperature probe situated directly next to the volume flow meter.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable
Description of measurement methods and	AM0034 requires the determination of gas volume flow at normal conditions in the stack. In order to calculate from the measured VSG values to VSG at normal



procedures to be applied:	conditions, the actual temperature in the stack is measured by a temperature probe directly next to the flow meter.
QA/QC procedures to be applied:	ISO9001/14001 procedures and documented in the applicable ISO handbooks.
Any comment:	None.

Data / Parameter:	P.7 PSG
Data unit:	bar
Description:	Pressure in the stack
Source of data to be used:	Stack pressure probe situated directly next to the volume flow meter.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable.
Description of measurement methods and procedures to be applied:	AM0034 requires the determination of gas volume flow at normal conditions in the stack. In order to calculate from the measured VSG values to VSG at normal conditions, the actual pressure in the stack has to be determined and applied to each hourly mean VSG value. The measurements are taken continuously by a pressure probe inside the stack very close to the stack gas volume flow meter.
QA/QC procedures to be applied:	ISO9001/14001 procedures and documented in the applicable ISO handbooks.
Any comment:	None.

Data / Parameter:	P.8 EF_n
Data unit:	tN ₂ O/tHNO ₃
Description:	Emissions factor for campaign n.
Source of data to be used:	Calculation from total mass N ₂ O emissions of campaign n (PE _n) and total nitric acid production (NAP _n).
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not available yet.
Description of measurement methods and procedures to be applied:	The campaign specific emissions factor for each campaign during the project's crediting period is calculated by dividing the total mass of N ₂ O emissions during that campaign by the total production of 100% concentrated nitric acid during that same campaign. For campaign n the campaign specific emission factor would be: $EF_n = PE_n / NAP_n$
QA/QC procedures to be applied:	Not applicable.
Any comment:	None

Data / Parameter:	P.9 EF_{ma,n}
Data unit:	tN ₂ O/tHNO ₃



Description:	Moving average emissions factor derived over time from campaign specific emissions factors.
Source of data to be used:	Calculation from campaign specific emissions factors EF_n .
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not available yet.
Description of measurement methods and procedures to be applied:	<p>In order to take into account possible long-term emissions trends over the duration of the project activity and to take a conservative approach a moving average emission factor shall be estimated as follows:</p> $EF_{ma,n} = (EF_1 + EF_2 + \dots + EF_n) / n$ <p>This process is repeated for each campaign such that a moving average, $EF_{ma,n}$ is established over time, becoming more representative and precise with each additional campaign.</p>
QA/QC procedures to be applied:	Not applicable.
Any comment:	None

Data / Parameter:	P.12 CL_n
Data unit:	tHNO ₃
Description:	Length of each project campaign measured in metric tonnes of 100% concentrated nitric acid produced during that campaign.
Source of data to be used:	NAP
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not available yet.
Description of measurement methods and procedures to be applied:	<p>In accordance with AM0034 the project length (CL_n) has to be compared to the established average historic campaign length (CL_{normal}); and</p> <p>If the length of each individual project campaign CL_n is longer than or equal to the average historic campaign length CL_{normal}, then all N₂O values measured during the baseline campaign can be used for the calculation of EF (subject to the elimination of data from the Ammonia/Air analysis).</p> <p>If $CL_n < CL_{normal}$, recalculate EF_{BL} by eliminating those N₂O values that were obtained during the production of tonnes of nitric acid beyond the CL_n (i.e. the last tonnes produced) from the calculation of EF_n.</p>
QA/QC procedures to be applied:	See comments for NAP.
Any comment:	None.

Data / Parameter:	P.13 EF_p
Data unit:	tN ₂ O/tHNO ₃



Description:	Emissions factor used for the specific campaign n to determine the emission reductions of that campaign
Source of data to be used:	Calculation of EF_n and $EF_{ma,n}$.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not available yet.
Description of measurement methods and procedures to be applied:	To calculate the total emission reductions achieved in a campaign, the higher of the two values $EF_{ma,n}$ and EF_n shall be applied as the emission factor relevant for the particular campaign to be used to calculate emissions reductions (EF_p). Thus: If $EF_{ma,n} > EF_n$ then $EF_p = EF_{ma,n}$ If $EF_{ma,n} < EF_n$ then $EF_p = EF_n$
QA/QC procedures to be applied:	Not applicable.
Any comment:	None

Data / Parameter:	P.14 EF_{min}
Data unit:	tN ₂ O/tHNO ₃
Description:	EF_{min} is equal to the lowest EF_n observed during the first 10 campaigns of the project crediting period.
Source of data to be used:	Calculations of $EF_{ma,n}$.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not available yet.
Description of measurement methods and procedures to be applied:	A campaign-specific emissions factor shall be used to cap any potential long-term trend towards decreasing N ₂ O emissions that may result from a potential built up of platinum deposits. After the first ten campaigns of the crediting period of the project, the lowest EF_n observed during those campaigns will be adopted as a minimum (EF_{min}). If any of the later project campaigns results in a EF_n that is lower than EF_{min} , the calculation of the emission reductions for that particular campaign shall used EF_{min} and not EF_n .
QA/QC procedures to be applied:	Not applicable.
Any comment:	None.

Data / Parameter:	OPh
Data unit:	bar
Description:	Oxidation Pressure for each hour
Source of data to be used:	Discharge of the air compressor before the ammonia to air mixer
Value of data applied for the purpose of calculating expected emis-	Not applicable. Used to determine when plant is operating outside of permitted range.



emission reductions in section B.5	
Description of measurement methods and procedures to be applied:	<p>In accordance with AM0034 the oxidation pressure in the ammonia oxidation reactor (OPh) has to be monitored and compared to the Normal range for oxidation temperature (OP_{normal}). VSG and NCSG data obtained during times when OPh was above or below OP_{normal} has to be eliminated from the calculation of EF_{BL}.</p> <p>AM0034 prescribes the monitoring and recording of the Oxidation Pressure for each hour (OPh) during the baseline campaign. This would imply the measurement of pressure inside the Ammonia Oxidation Reactor. In the case of N3, the pressure probe is located at the discharge of the air compressor before the ammonia to air mixer. Since the location of this probe remains the same during the historic campaigns, the baseline campaigns and the project campaigns, it is appropriate to use this value for comparison of OPh between these campaigns.</p>
QA/QC procedures to be applied:	Subject to ISO 9001/14001 procedures.
Any comment:	None.

Data / Parameter:	OTh
Data unit:	°C
Description:	Oxidation temperature in the ammonia oxidation reactor (AOR).
Source of data to be used:	Monitoring results of three thermocouples inside the ammonia oxidation reactor and recorded by the data acquisition system.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable. Used to determine when plant is operating outside of permitted range.
Description of measurement methods and procedures to be applied:	<p>In accordance with AM0034 the oxidation temperature in the ammonia oxidation reactor (OTh) has to be monitored and compared to the Normal range for oxidation temperature (OT_{normal}).</p> <p>VSG and NCSG data obtained during times when OTh was above or below OT_{normal} has to be eliminated from the calculation of EF_{BL}.</p>
QA/QC procedures to be applied:	Subject to ISO 9001/14001 procedures.
Any comment:	None.

Data / Parameter:	AFR
Data unit:	tNH ₃ /h
Description:	Ammonia gas flow rate to the ammonia oxidation reactor.
Source of data to be used:	Coriolis flow meter
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable, monitored data of AFR will be used to determine if plant was operating outside of AFR_{max} .



section B.5	
Description of measurement methods and procedures to be applied:	The ammonia flow is continuously measured by coriolis flow meter.
QA/QC procedures to be applied:	Subject to ISO 9001/14001 procedures.
Any comment:	None.

Data / Parameter:	AIFR
Data unit:	% v/v
Description:	Ammonia to air ratio into the ammonia oxidation reactor
Source of data to be used:	Calculation for each hour of plant operation based on measurements of AFR and primary air flow rates.
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Not applicable
Description of measurement methods and procedures to be applied:	<p>The monitoring of AIFR is required by AM0034 in order to determine whether the plant was operating within the permitted operating range. In the baseline procedures AIFR_{max} was determined to be 11.5% v/v. During the analysis of the measured data, any of the NCSG and VSG data obtained from an hour during which the AIFR was above AIFR_{max} will be eliminated from the calculation of EF_p.</p> <p>AIFR is calculated from AFR and the primary air flow to the ammonia oxidation reactor. The airflow rate is measured by orifice plate and expressed in kg/hr and is then converted to Nm³/hr, which is used in the ratio calculation</p>
QA/QC procedures to be applied:	Subject to ISO 9001/14001 procedures.
Any comment:	None.

B.7.2 Description of the monitoring plan:

The emission reductions achieved by the project activity will be monitored using the approved monitoring methodology AM0034 as prepared by N.serve Environmental Services GmbH. It is the appropriate monitoring methodology to be used in conjunction with the baseline methodology AM0034, “Catalytic reduction of N₂O inside the ammonia burner of nitric acid plants”. Its applicability depends on the same prerequisites as the mentioned baseline methodology.

AM0034 requires the use of the European Norm EN14181 (2004) “Stationary source emissions - Quality assurance of automated measuring systems”¹⁹ as a guidance for installing and operating the Automated Monitoring System (AMS) in the nitric acid plants for the monitoring of N₂O emissions.

A complete Automated Monitoring System (AMS) to monitor the mass emissions of N₂O at the stack of Haifa Chemicals’ N1 nitric acid plant was installed and has been operated since Q1, 2006. As an operator

¹⁹ This standard describes the quality assurance procedures needed to assure that an Automated Measuring System (AMS) installed to measure emissions to air are capable of meeting the uncertainty requirements on measured values given by legislation, e.g. EU Directives, or national legislation, and more generally by competent authorities.



of the nitric acid plants for many years and of dedicated NO_x and other emissions monitoring equipment, Haifa Chemicals staff in general and its Instrument Department in particular is accustomed to operating technical equipment to a high level of quality standards.

The plant manager is responsible for the ongoing operation and maintenance of the N₂O monitoring system. Operation, maintenance, calibration and service intervals are being carried out by staff from the instrumentation department according to the vendor's specifications and under the guidance of internationally relevant environmental standards, in particular EN 14181 (2004) and EN ISO 14956 (2002).

All monitoring procedures at Haifa Chemicals are also conducted and recorded in accordance with the well established procedures under ISO 9001/14001 which is regularly audited by an independent auditing firm accredited for ISO 9001/14001 certification.

Please see 4 for a detailed description of the Automated Monitoring System (AMS) installed at Haifa Chemicals' N1 nitric acid plant and for background information on EN 14181 and the practical implications for using this standard for guidance in the implementation of this CDM project activity.

In the following, it is described how the procedures given in EN14181 for QAL1, 2 and 3 have been practically applied at Haifa Chemicals' N1 plant.

QAL 1

In accordance with EN14181 an AMS shall have been proven suitable for its measuring task (parameter and composition of the flue gas) by use of the QAL1 procedure as specified by EN ISO 14956. 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. Such suitability testing has to be carried out under specific conditions by an independent third party on a specific testing site. A test institute shall perform all relevant tests on two identical AMS. These two AMS have to be tested in the laboratory and field.

At the time of commissioning of the AMS by Haifa Chemicals in early 2006, no AMS was available that had been certified according with EN14181 for N₂O measurements. Even to date, no analyser has been finally certified to comply with the requirements of EN 14181 QAL 1 in accordance with ISO 14956.

However, ABB has since conducted the QAL1 tests for the Uras 26, which is the follow-up model of the Uras 14. According to ABB the two models are very similar. The QAL1 tests for the Uras 26 have recently been completed by successfully, conducted by TÜV in Germany, but the final results are yet to be published officially in the *Bundesanzeiger* (German Federal Publication of all laws, companies, patents, certifications, etc.) before taking effect. Nevertheless, because the two models are very similar, it is assumed that the QAL1 results for the Uras 26 can be transposed onto the Uras 14 as installed at Haifa Chemicals.

The Analyser and Flow Meter were calibrated by the vendors (ABB and Emerson Rosemount) prior to shipment and installation in the nitric acid plant²⁰.

Pre-validation of the AMS by a DOE

While this is not explicitly required by either AM0034 or EN14181, a pre-validation of the AMS installation and operation was conducted on site in May 2006 by SGS to help ensure that the AMS output and the monitoring procedures implemented in the plant are going to be acceptable to the DOE upon validation of the project.

QAL2

²⁰ The calibration report can be reviewed by the DOE during the site visit as part of the validation.



QAL2 is a procedure for the determination of the calibration function and its variability, and a test of the variability of the measured values of the AMS compared with the uncertainty given by legislation. The QAL2 tests are performed on suitable AMS that have been correctly installed and commissioned on-site (as opposed to QAL 1 which is conducted off-site). QAL 2 tests are to be performed at least every 5 years according to EN 14181 but also after major changes to the plant or changes or repairs to the AMS, which will influence the results obtained significantly.

A calibration function is established from the results of a number of parallel measurements performed with a Standard Reference Method (SRM). The variability of the measured values obtained with the AMS is then evaluated against the required uncertainty. According to EN14181, both the QAL 2 procedures and the SRM need to be conducted by an independent “testing house” or laboratory which has to be accredited to EN ISO/IEC 17025.

The project participants are currently negotiating with several accredited QAL2 auditors to arrange for these tests to be undertaken according to EN 14181 requirements. They expect that a QAL2 report will be available for the final PDD, on the basis of which the registering request will be based.

Israel currently has no testing house or laboratory that would meet the accreditation requirements of EN 14181.

AMS calibration and QA/QC procedures

The relevant measurement procedures and routines have all been incorporated into the ISO 9001/14001 procedures and are documented in the relevant ISO handbooks and checked and certified by the ISO accredited technical auditing company.

Calibration Gas

Calibration gas with a concentration of 1600ppmv (balance being N₂) with a precision of $\pm 1\%$ is used in the automatic span calibrations. The calibration gas is certified by the manufacturer that the analytical examination of the concentration of N₂O in the balloon has been performed in a laboratory that is designated from the national authority according to standard ISO 17025.

Analyser Zero and Span Calibrations

Zero and span calibrations are conducted automatically on the analyser at least once per day. These automatic calibrations in the Uras 14 are carried out with a „Calibration Cuvette“, which is installed as part of the analyser. The automatic calibration unit for zero and span point must be checked yearly.

In case of a warning of deviation from automatic calibration greater than 1%, it is necessary to calibrate the N₂O analyzer. The calibration results and subsequent actions are all documented with the following information: Name of the person performing the calibration, date, in order/not in order, next date of calibration.

In addition, the analyser room and equipment is visually inspected at least once a week, the results are documented.

Flow meter calibration procedures

The thermostats, pressure gauges and pressure fall meters in the stack flow meter will be calibrated at least once a year with equipment that has been examined by the suitable standardization institute (with national or international designation).

In addition, the flow meter will be physically and visually inspected at regular intervals.



Training

Operations-staff at the nitric acid plant who are responsible for the operation of the AMS and regular calibrations, visual and physical checks have been trained appropriately by the AMS vendors and Haifa Chemicals' own instrumentation engineers.

QAL3

QAL3 is a procedure which is used to check drift and precision in order to demonstrate that the AMS is in control during its operation so that it continues to function within the required specifications for uncertainty.

This is achieved by conducting periodic zero and span checks on the AMS and then evaluating the results obtained using control charts. Zero and span adjustments or maintenance of the AMS, may be necessary depending on the results of this evaluation. In addition, Annual Surveillance Tests (AST) should be conducted in accordance with EN14181, these are a series of measurements that need to be conducted by independent measurement equipment in parallel to the existing AMS.

In essence, Haifa Chemicals staff performs QAL 3 procedures through the established calibration procedures described above. However, similarly to QAL2, there is no independent, qualified and certified entity in Israel that could conduct the QAL 3 procedures and particularly the AST in accordance with EN14181. Therefore, either a sufficiently qualified (but not certified in accordance with EN14181) technical surveillance company or laboratory could perform the independent QAL 3 procedures. Or alternatively a certified auditor from Europe will have to be called in to conduct the QAL 3 procedures.

Data acquisition system

The analogue signal (4 to 20 mA) output from the Analyser and Flow meter are converted into a digital signal which is then fed into the data acquisition system. The data acquisition system performs calculations to derive the hourly averages for each of the parameters. These are then extracted and converted into .csv files which can then be imported into the N.serve Database Management System (N.DBMS) as described in section B.6.3 above.

Monitoring Procedures for parameters other than NCSG and VSG

Throughout the crediting period of the project the following parameters shall be monitored and recorded as described in section B.7.1 above: OT_h, OP_h, AFR, AIFR, NAP, GS, GC, CL, incoming N₂O regulation and changes in the NO_x regulations.

All of the data obtained and used as part of the baseline and during the crediting period of the project will be archived electronically for at least 2 years in at least 2 different locations.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

15. February 2007

Haifa Chemicals Ltd., Mrs. Efrat Shamgar and Mr. Benny Fetter

N.serve Environmental Services GmbH
Albrecht von Ruffer, Dr. Marten von Velsen-Zerweck
(Database management by Dr. Helmuth Groscurth)

**SECTION C. Duration of the project activity / crediting period****C.1 Duration of the project activity:**

10 years

C.1.1. Starting date of the project activity:

1st July 2007 (unless the registration of the project activity with the CDM EB occurs after that date; in this case the day after the registration will be the starting date of the project activity.)

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

Haifa Chemicals' N1 nitric acid plant has a remaining operational lifetime of at least 10 years and is not expected to be decommissioned before that time.

C.2 Choice of the crediting period and related information:

The project participants have chosen a fixed term crediting period of ten years.

C.2.1. Renewable crediting period**C.2.1.1. Starting date of the first crediting period:****C.2.1.2. Length of the first crediting period:****C.2.2. Fixed crediting period:**

10 years

C.2.2.1. Starting date:

1st July 2007

C.2.2.2. Length:

10 years

SECTION D. Environmental impacts**D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:**

The project will reduce gaseous emissions of nitrous oxide (N₂O) from the plant tail gas and will therefore contribute to international efforts to reduce greenhouse gas emissions. The project will have no effects on local air quality.

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

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

The N₂O abatement catalyst will be leased from an overseas supplier. The catalyst will be replaced from time to time and the spent catalyst returned to the supplier for recycling, if possible.

There are no other positive or negative impacts on the environment.



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

The Israeli Planning and Building Law (2003) lists the project categories that require an Environmental Impact Assessment (EIA); the proposed project at Haifa Chemicals does not fall into any of the categories and therefore no EIA is required²¹.

SECTION E. Stakeholders' comments

E.1. Brief description²² how comments by local stakeholders have been invited and compiled:

Local Stakeholder Consultation process for Haifa Chemicals

The stakeholder consultation process was conducted by Netco carbon consultants (Israel), simultaneously for all four nitric acid plants operated by Haifa Chemicals (N1 and N2 near the city of Haifa in northern Israel and N3 and N4 at Mishor Rotem in southern Israel).

The list of contact details of all identified and contacted stakeholders is shown below. Copies of the letters and email sent as well as a log of the phone calls made are available and can be viewed by the DOE on request.

Personal Letters

Personal letters were sent to environmental and social NGOs in the Haifa and Mishor Rotem Regions, relevant municipality authorities and governmental offices.

The letters described the Clean Development Mechanism in general and the project activity in Haifa and Mishor Rotem. Stakeholders were invited to send comments or questions. The letter also referred the stakeholders to a special webpage on the homepage of the local representative of the carbon consultant (<http://www.netco.co.il>). The webpage included a special form in Hebrew for a fast and simple on-line submission of comments. The webpage has been open since 9 July, 2006 and will remain open for comments on the N1 plant until the beginning of the Global Stakeholder Consultation process conducted by the DOE.

No comments were received.

²¹ http://www.sviva.gov.il/Environment/Static/Binaries/law/klali37_1.pdf

²² More detailed information on the stakeholder consultation process than contained in the PDD is to be found in the Stakeholder Engagement Report.



Personal Letters				
Organization	Stakeholder	Address/Fax number	Date letter was sent	Response
The Public Forum Carmel – Residents' forum for Carmel and Haifa	Mr. Yaron Hanan, coordinator	Fax: 972(0)4 810 1548	9.7.2006	No response to letter.
The Coalition for Public Health, Haifa and North Region	Ms Keren Malchiel Yitzkar , coordinator	Haganim street 10 Haifa 35024	09-Jul-06	No response to letter. See phone conversation.
Ministry of the Environment, South District	Mr. Arik Bar-Sade, Director	P.O.Box 230 Beer Sheva 84102	09-Jul-06	No response
Ministry of the Environment, Haifa District	Mr. Robert Reuven Director	Pal Yam Ave. 15A Building B Government Campus Haifa 33095	09-Jul-06	A letter dated 8 August, 2006 was received requesting the project will be presented to the air quality coordinator. Following the letter, the project was described to the coordinator in a phone conversation. No further comments received since.
Haifa District Municipal Association for the Environment	Mr. Tzvi Fogel Director	P.O.Box 25028, Haifa 31250	09-Jul-06	No response to letter. See phone conversation.
The Society for the Protection of Nature in Israel – Haifa Branch	Ms. Vered Friedman Director	Fax:972(0)4 855-3864	28-Sep-06	No response to letter. See phone conversation.
The Association for the Environment – Kriat Tivon	Mr. Yossi Costi, coordinator	P.O.Box 1144 Kiryat Tivon	09-Jul-06	No response.
Life and Environment – The Israeli Union of Environmental NGOs	Ms Alona Sheffer, Director	Nahalat Benyamin street 85 Tel Aviv 66102	09-Jul-06	No response to letter. See phone conversation.
Our Haifa Organization	Mr. Shmuel Gilbhart	Ayalon street 4 Haifa	09-Jul-06	No response.
Sustainable Development for the Negev	Ms Givon Belha	P.O.Box 125 Omer 84965	09-Jul-06	No response to letter. See phone conversation.
Blue and Green Association- Association for the preservation of the environment in the Carmel region.	Ms Tali Mersland, coordinator	P.O.Box 1429 Zichron Yaacov 30900	9.7.2006	No response.
Dimona Municipality		Fax: 972(0)8 655-0105	09-Jul-06	No response.
Arad Municipality	Dr. Motti Brill, Mayor	P.O.Box 100 Arad	09-Jul-06	No response.
Haifa Municipality	Mr. Yona Yahav, Mayor	P.O.Box 4811 Haifa 31047	09-Jul-06	A letter was received on the 6th of August, 2006 acknowledging the letter was received. No comments were received.
Kiryat Ata Municipality	Mr. Yaacov Perez, Mayor	Fax: 972(0)4 844 9383	09-Jul-06	No response.
Local Authority Kyriat Tivon	Mr. Alon Navot, Director	Ben Guryon Sq. 1 Kiryat Tivon	09-Jul-06	No response.
Local Authority Kiryat Biyalik	Dr. Raffi Verthaim, Director	Jerusalem Ave. 16 Kiryat Bialik	09-Jul-06	No response.
The Planning and Developing Association in Haifa	Prof. Arza Cherchman, coordinator	Center of Urban Planning and Regional Studies Technion Haifa 32000	09-Jul-06	No response.



Phone Conversations

Follow up phone calls were made to most of the stakeholders who had received personal letters. The objective of the phone call was to remind them of the stakeholder consultation process and encourage them to send their comments. The stakeholders were referred to the special webpage for information about the project. However, they were also given the choice to submit their comments by email, fax, phone or regular mail. The Project Idea Note was sent by email to stakeholders who requested further information about the project activity.

No comments were received to date.

Phone Conversations				
Organization	Stakeholder, Title	email/fax	Date	Conversation remarks
The Coalition for Public Health	Mr. Shay Cohen, coordinator	shay.ph@gmail.com	01-Nov-06	The project activity was described briefly. Project Idea Note was sent following request.
Ministry for the Protection of the Environment	Mr. Camel Kazamel, air quality coordinator	kamelq@sviva.gov.il	19-Oct-06	The project activity was described briefly. A date for a presentation is being arranged.
Citizens for the Environment in the Galilee	Ms. Liora Aharon, coordinator		30-Oct-06	The project activity was described briefly. The stakeholder was referred to special webpage. No comments were received.
Life and Environment – The Israeli Union of Environmental NGOs	Mr. Naor Yerushalmi, Vice President	naor@sviva.net	16-Oct-06	The project activity was described briefly. The stakeholder was referred to special webpage. No comments were received.
Haifa District Municipal Association for the Environment	Bella Ben David, Air Quality Coordinator	bellabd@envihaifa.org.il	09-Nov-06	The project activity was described briefly. Project Idea Note was sent upon request.
Sustainable Development for the Negev	Ms. Bilha Givon, Director	bilha@negev.org.il	09-Nov-06	The project activity was described briefly. Project Idea Note was sent following request.
Public Forum Carmel	Ms. Hadara Ben-Yosef, coordinator		29-Oct-06	The project activity was described briefly. The stakeholder was referred to special webpage. No comments were received.
The Society for the Protection of Nature in Israel – Haifa Branch	Ms. Vered Friedman, Director	Fax: 972(0)4 855-3864	28-Sep-06	The project activity was described briefly. The stakeholder was referred to special webpage. No comments were received.

Newspaper Advertisement and Article

An advertisement was published in a major Haifa Region newspaper “Zman Maariv” on 7th July, 2006. The advertisement informed the public about the CDM activity in Haifa Chemicals and referred to the special webpage for information about Clean Development Mechanism and the project activity. The advertisement invited the public to send their comments or questions regarding the CDM project.

Also, an article about the project was posted in the same newspaper edition. The article described in general the CDM and the project activity in Haifa Chemicals. The article pointed out that a stakeholder’s consultation process is currently being carried out.

The article included three comments on the project activity:

Mr. Robert Reuven, Head of the Haifa District of the Ministry of the Environment: “The activity of the production plant is welcomed and will contribute to the environment”.

Mr. Jimmy Krikon, a representative of the Coalition for the Public Health: “The polluting plants have no right to operate in Haifa. With all respect to them and to their future plans, they hold very dangerous materials. Because of public pressure they are doing something which is encouraging, but is too late. Thousands of people became ill and died because of these plants. Haifa and the Krayot civilians will be paying



the price for many years more. The Ministry for the Protection of the Environment is supposed to limit them, but for years the ministry has preformed its duty in a poor way and we no longer have faith in it.”

Spokesman of the Ministry for the Protection of the Environment: “The Ministry for the Protection of the Environment views this project as a means for promoting ‘clean technologies’ and as a first of a kind project that will encourage other plants to join this process”.

No comments were received further to the newspaper advertisement or the article.

Environmental Forums

Three major environmental internet forums were identified in Israel (Nana, Ynet and Tapuz) and emails were sent to the forum directors informing them of the project activity and the stakeholder consultation process. Subsequently messages were posted in these environmental forums. The messages informed the forum participants of the stakeholder consultation process, referred them to the special webpage and encouraged them to send comments.

Environmental Forums		
Forum Name	Date message posted	address
Nana	06-Oct-06	http://forums.nana.co.il/Forum/?ForumID=2074
Ynet	02-Oct-06	http://www.ynet.co.il/home/0,7340,L-870-7715,00.html
Tapuz	06-Oct-06	http://www.tapuz.co.il/tapuzforum/main/forumpage.asp?id=174

Several comments were received. However, these comments were all on Haifa Chemicals in general rather than on the specific project activity.

E.2. Summary of the comments received:

Despite the efforts made by the project participants, no comments were received regarding the specific project activity. Some stakeholders commented in general about Haifa Chemicals with no relation to the CDM project. Several stakeholders asked to receive the Project Idea Note in order to get some more information about the project, PINs were sent to those stakeholders who had requested them.

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

Overall very few comments were received and none of the comments were specific about the project activity. The project proponents interpret this as an indication of the low or non-existent level of impact that the project will have on local environmental or social conditions.

As a result, no changes had to be considered in the implementation of the project activity.

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

Organization:	Haifa Chemicals Ltd.
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding was received by the project participants for the development, implementation and operation of the project.

**Annex 3****BASELINE INFORMATION**

Excerpt from the measurement reports during the baseline campaign²³:

N2 plant baseline campaign

Calculation constants

Campaign start	15/11/2006	V ideal gas	22.415 m ³ /kmol
Campaign end	28/01/2007	Mw N ₂ O	44.013 kg/kmol

Date	OTh	OPh	AFR	AIFR	NAP	VSG	NCSG
24-08-06 19:00:00	909.7326245	10.17013	2982.152	0.103965	8654.403	30128.5215	2996.625
24-08-06 20:00:00	911.5306334	10.2083	3020.817	0.104024	9640.875	30331.79872	2914.444
24-08-06 21:00:00	911.1659611	10.33592	2991.42	0.103913	9932.95	30317.18826	2878.116
24-08-06 22:00:00	911.6442254	10.22399	2952.751	0.104345	9867.043	30056.25176	2805.096
24-08-06 23:00:00	911.7847965	10.21245	3024.374	0.104381	9902.174	30301.72543	2750.948
25-08-06 00:00:00	917.3822019	10.21245	2982.608	0.10557	9968.063	30151.5729	2560.606
25-08-06 01:00:00	918.8516671	10.25264	3023.921	0.105142	10104.07	30404.75726	2448.835
25-08-06 02:00:00	918.8776668	10.38266	2990.577	0.10572	10249.56	30613.05636	2423.733
25-08-06 03:00:00	918.9170278	10.29255	2976.755	0.105645	7523.826	30302.46216	2380.942
25-08-06 04:00:00	918.9490051	10.21245	2961.79	0.105392	8490.341	30165.42565	2358.922
25-08-06 05:00:00	918.848147	10.21245	2972.047	0.105625	9983.527	30239.30395	2347.168
25-08-06 06:00:00	918.880491	10.21245	2973.823	0.105556	9980.387	30349.18329	2345.53
25-08-06 07:00:00	919.0173944	10.21245	2975.643	0.105257	9991.585	30336.10589	2332.628
25-08-06 08:00:00	919.2308024	10.21245	2974.257	0.10559	9984.131	30373.19231	2322.121
25-08-06 09:00:00	919.1167798	10.21245	2959.136	0.105751	9965.792	30268.38526	2306.21
25-08-06 10:00:00	919.0641516	10.21245	2948.047	0.105515	9886.44	30140.17837	2277.887
25-08-06 11:00:00	919.0307039	10.21245	2933.786	0.105248	9853.267	30135.73871	2258.035
25-08-06 12:00:00	919.0841212	10.21245	2927.105	0.105267	9860.97	30110.04914	2253.086
25-08-06 13:00:00	918.9315522	10.21245	2925.994	0.105696	9850.739	30034.71421	2235.801
25-08-06 14:00:00	918.9895954	10.21245	2916.327	0.105356	9790.785	29634.67016	2215.002
25-08-06 15:00:00	918.9248284	10.21245	2917.566	0.10528	9788.666	29797.07946	2218.551
25-08-06 16:00:00	919.0228127	10.08106	2906.504	0.105616	9840.491	29754.65933	2215.498
25-08-06 17:00:00	918.7782823	10.04225	2908.033	0.105861	9937.032	29678.42326	2213.968
25-08-06 18:00:00	918.8463865	10.04225	2919.745	0.105641	9993.003	29786.64057	2211.869
25-08-06 19:00:00	918.7769189	10.04225	2923.169	0.106054	9878.381	29753.1988	2206.019
25-08-06 20:00:00	918.927003	10.167	2951.044	0.105548	9950.925	30149.47672	2216.693
25-08-06 21:00:00	918.8840699	10.21245	2973.943	0.105719	9972.791	30443.99041	2213.694
25-08-06 22:00:00	918.6199436	10.35931	3001.361	0.105741	9983.925	30707.47101	2216.925
25-08-06 23:00:00	918.7635496	10.38266	3022.592	0.106342	10053.26	30960.31547	2219.548
26-08-06 00:00:00	918.4339796	10.38266	3012.81	0.105936	10196.02	30915.53979	2226.292
26-08-06 01:00:00	918.7062443	10.38266	2983.966	0.105466	10188.43	30839.12597	2213.237
26-08-06 02:00:00	918.7567433	10.38266	3006.516	0.103851	10153.36	30513.94437	2197.95

²³ The complete data series is available for review and inspection by the DOE at any time.



Annex 4

MONITORING INFORMATION

A. Background on EN14181

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

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

- Specific procedures for N₂O are not yet defined in EN14181;
- Only very limited experience exists with monitoring systems for N₂O emissions;
- No applicable regulatory N₂O levels exist in the EU (or elsewhere) that are required to conduct some of the calculations and tests of EN14181; and

As a result, at the time of ordering and installation of the AMS at Haifa Chemicals' nitric acid plants, no AMS vendors had yet achieved the certification for suitability in accordance with EN14181.

However, N₂O is expected to be regulated in the EU starting in 2008, the Council Directive 96/61/EC on integrated pollution prevention and control is under preparation under the lead of the European IPPC Bureau (<http://eippcb.jrc.es/>). Only once the regulatory limits and the framework for N₂O measurements have been established can and will AMS vendors finally conduct the suitability testing in accordance with EN14181.

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

Despite all this, EN14181 provides a very useful guidance in conducting a logical, step-by-step approach to selecting, installing, adjusting and operating the N₂O AMS for CDM projects.

The monitoring procedures developed for this project under AM0034 aim at providing workable and practice orientated solutions that take into account national environmental standards and regulations, available monitoring and testing expertise in the country as well as the specific situation at each nitric acid plant. Wherever possible, EN14181 is applied as guidance for the development and implementation of the monitoring procedures for this CDM project in order to achieve highest possible measuring accuracy and to implement a quality control system that assures transparency and credibility.

Scope of EN 14181

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

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



EN14181 specifies:

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

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

B. Description of the AMS installed at Haifa Chemicals' N1 plant

1. Sample Point

The location of the sample point was selected to provide ease of access and a location close to the analyser. The sampling points for both NCSG and VSG are at least 3 times the stack diameter distance after any previous bend in the stack and behind the tail gas expander turbine.

2. Analyser

The analyser installed at Haifa Chemical South's N1 nitric acid plant to continuously monitor N₂O concentration in the stack is an ABB AO2000 Uras 14 NDIR analyser. According to ABB's own certificate, this analyser has an accuracy of better than 1% of range.

This analyser has been certified²⁴ as meeting the requirements of the German emissions standard 7th BImSchV (waste incineration plants, large furnaces and others) with the following results:

- Availability: > 98 % over a three months period for two independent systems, including sample conditioning.
- Zero point drift: < 2% of span per year
- End point drift <4% of set point per year

The automatic calibrations in the Uras 14 are carried out with a „Calibration Cuvette“, which is installed as part of the analyser. The automatic calibration unit for zero and span point must be checked yearly.

3. Flow Meter

The stack gas volume flow meter installed at Haifa Chemicals' N1 plant is a Rosemount 3095MFA Mass ProBar® Flowmeter (pictured below) from the Annubar® Flow Meter series.

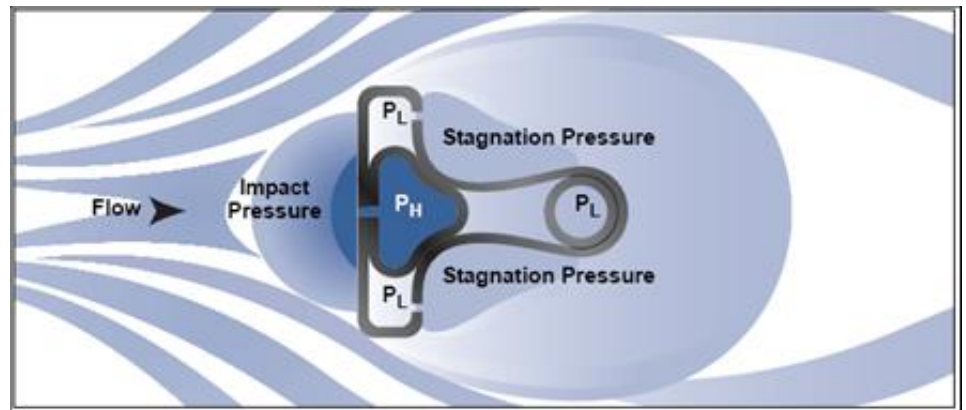
It measures by creating a differential pressure (DP) that is proportional to the square of the velocity of the fluid in the pipe, in accordance with Bernoulli's theorem. This DP is measured and converted into a flow rate using a secondary device, such as a DP pressure transmitter.

The Annubar generates a DP by partially blocking the flow. The velocity of the fluid is decreased and stalled as it reaches the upstream surface of the Annubar sensor, thus creating the Impact Pressure.

²⁴ TÜV Süddeutschland Bau und Betrieb GmbH (Report number 170 608), March 2003



Rosemount 3095MFA
Mass ProBar Flowmeter



As the flow continues around the Annubar sensor, it creates a lower velocity profile on the back of the sensor, creating the low/suction pressure downstream. Individual ports, located on the backside of the Annubar sensor measure this low pressure. Working on the same principle as with high pressure, an average low pressure value is obtained in the low pressure chamber that connects directly into the transmitter for measurement. The resulting differential pressure is the difference between the impact (high) pressure reading and the suction (low) pressure reading as shown on the picture above right.

According to the manufacturer the Rosemount 3095MFA Mass ProBar® Flowmeter has an overall measurement accuracy of $\pm 1.0\%$ of mass flow rate in gas and a repeatability of $\pm 0.1\%$.

Static pressure and process temperature are measured with a single pipe penetration, compensated (Normal) flow is calculated dynamically.

If the flow meter detects a transmitter failure (self-diagnostics), the analog signal will be driven either below 3.75 mA or above 21.7 mA to alert the user (normal output signal is 4 to 20 mA).