



**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 N<sub>2</sub>O emissions with a secondary catalyst inside the ammonia reactor of the N3 nitric acid plant at Haifa Chemicals Ltd., Israel.

Version 1.0, date of completion: 17. November 2006

**A.2. Description of the project activity:**

The sole purpose of the proposed project activity is to significantly reduce current levels of N<sub>2</sub>O emissions from the production of nitric acid at one of Haifa Chemicals' nitric acid plants (the "N3 Plant") at Mishor Rotem Arava, Israel. The N3 nitric acid plant was designed by Weatherly and commissioned in 1992, it is a single burner high pressure plant operated at 11 to 12 bar gauge.

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

To produce nitric acid, ammonia (NH<sub>3</sub>) 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 NO<sub>2</sub>, which is later absorbed in water to form HNO<sub>3</sub> – nitric acid. Simultaneously, undesired side reactions yield nitrous oxide (N<sub>2</sub>O), nitrogen and water. N<sub>2</sub>O is a potent greenhouse gas with a Global Warming Potential (GWP) of 310<sup>1</sup>. The project activity involves the installation of a new N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O abatement catalyst and the Automated Monitoring System.

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.

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<sup>1</sup> IPCC Second Assessment Report (1995)

**A.3. Project participants:**

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

**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:**

Mishor Rotem Arava 86800

**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 (N3 and N4). The postal address is Mishor Rotem Arava 86800. This PDD covers only the N3 nitric acid plant operated at this location.



Regional map indicating the location of the N3 plant near the city of Beer Sheeba



Aerial view of Haifa Chemicals South at Mishor Rotem



Picture of the N3 plant at Mishor Rotem



**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 N<sub>2</sub>O abatement technology which is not even commonly applied in Annex I countries.
- Specialised monitoring equipment
- Training of staff for installation, operation and maintenance of catalyst and monitoring equipment, etc.

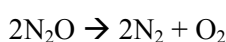
A number of N<sub>2</sub>O abatement technologies have become available in the past 2 years after some 10 years of research, development and industrial testing. Only now that N<sub>2</sub>O regulation is going to be introduced in the EU by 2007 and with the incentives provided by the Kyoto Protocol nitric acid plant operators are considering adopting these technologies. N<sub>2</sub>O 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 N<sub>2</sub>O abatement of the global nitric acid industry.

Haifa Chemicals is determined to install a secondary abatement catalyst upon the successful registration of the N3 plant as a CDM project.

**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 N<sub>2</sub>O 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 N<sub>2</sub>O 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 N3 normally operates at between 890 and 925°C, which causes 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 N3 ammonia reactor has a diameter of 1118 mm that expands by several millimeters when in operation resulting in a gap between the pelleted bed and the burner's outside wall. This gap will be of significantly lower ΔP than the pelleted bed. Hence an in-



crease in gas flow will emerge equilibrating the  $\Delta P$  throughout the system. The preferential gas flow through this gap can easily increase tenfold due to this effect.

To counter this occurrence, the basket which supports the gauze pack will have to be modified and an additional heat shield will have to be installed inside the existing basket to provide containment of the pelleted bed in a manner which prevents preferential gas flow at the perimeter.

#### **N<sub>2</sub>O 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 operates at high pressure of 11.7 bar inside the ammonia oxidation reactor. Through the introduction of the secondary catalyst into the ammonia reactor, a slight pressure drop ( $\Delta P$ ) of 69.7 mbar is expected to occur. This  $\Delta P$  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 N<sub>2</sub>O and environmentally safe. Especially, its implementation does not lead to increased NO<sub>x</sub> emissions. Neither is the environment directly or indirectly harmed in any other way.

The N<sub>2</sub>O 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:**

From the data collected during the baseline campaign an N<sub>2</sub>O emissions factor ( $EF_{BL}$ ) of 7.33 kg per tonne of 100% concentrated nitric acid has been established. The average production of the N3 nitric acid plant is 79,200 tonnes of 100% concentrated nitric acid per year, based on the actual daily capacity of 240 tonnes and 330 days of operation per year.

Multiplied by the  $EF_{BL}$ , the annual baseline emissions are 180,023 tCO<sub>2</sub>E. Assuming an 80% abatement efficiency of the N<sub>2</sub>O abatement catalyst, the project emissions for the same production output of nitric acid would be 36,005 tCO<sub>2</sub>E. The resulting amount of emission reductions therefore would be 144,018 tCO<sub>2</sub>E 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<br>[tCO <sub>2</sub> E] |
|--|---|
| 1  | 144,018   |
| 2  | 144,018   |
| 3  | 144,018   |
| 4  | 144,018   |
| 6  | 144,018   |
| 7  | 144,018   |
| 8  | 144,018   |
| 9  | 144,018   |
| 10   | 144,018   |
| Total number of crediting years                                  | 10  |
| Total estimated Emission Reductions                              | 1,440,180   |
| Annual average over the crediting period of estimated reductions | 144,018   |

#### **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**

#### **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 N<sub>2</sub>O inside the ammonia burner of nitric acid plants”.

The project draws on approved baseline methodology AM0028 (Version 03) for the baseline scenario selection and uses the “Tool for the demonstration and assessment of additionality” (Version 02).

#### **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

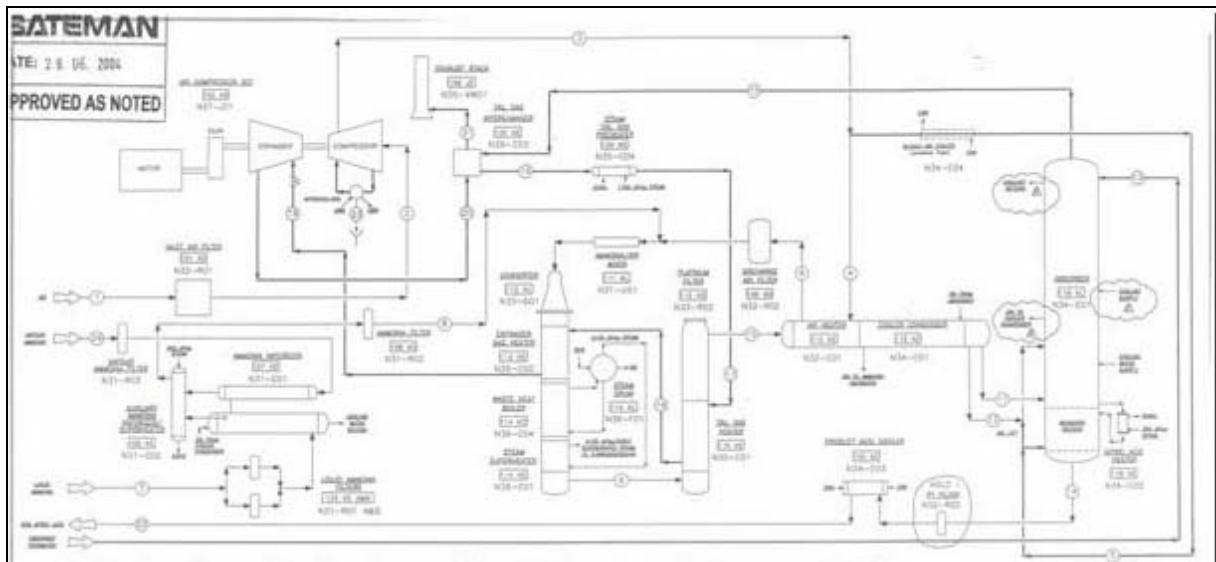
1. The proposed project activity will be applied to an existing production facility installed prior to the 31<sup>st</sup> December 2005. The plant has been commissioned and is in operation since 1992. The existing nameplate production capacity is 94,900 tonnes of 100% concentrated nitric acid per

year (based on 365<sup>2</sup> operating days per year and a daily nameplate capacity of 260 t/d tonnes of nitric acid)

2. Currently, the plant does not have any N<sub>2</sub>O destruction or abatement facilities that could be affected by the project activity.
3. The project activity has no influence on the plant's nitric acid production levels.
4. The host country has no legal requirements to reduce N<sub>2</sub>O emissions from nitric acid plants.
5. Presently, no N<sub>2</sub>O abatement technology is installed in the plant.
6. The project activity will not increase in NO<sub>x</sub> emissions.
7. There is no NSCR DeNO<sub>x</sub>-unit installed in the plant.
8. The installation of the secondary N<sub>2</sub>O abatement catalyst will not lead to any additional direct or indirect GHG emissions within the project boundary.
9. A complete Automated Monitoring System (AMS) comprised of an N<sub>2</sub>O analyser (27 December 2005) and a gas volume flow meter (23 February 2006) have been installed in the appropriate location 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

The following flow-chart displays the nitric acid plant on which the project activity is to be applied. It also indicates the location, where the secondary N<sub>2</sub>O abatement technology will be installed. The boundary of the project activity includes the complete process equipment of the No. 9 nitric acid plant as shown on the flow chart below<sup>3</sup>.



<sup>2</sup> As per AM0034 page 11.

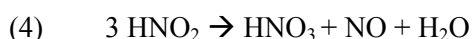
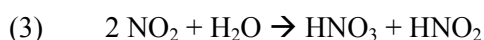
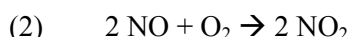
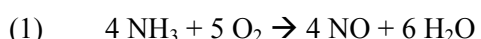
<sup>3</sup> The more legible original Process Flow Diagramme is available on-site for the DOE at validation.





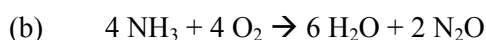
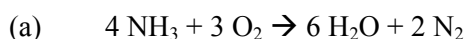
The gases relevant to the proposed project activity (and the nitric acid plant which is subject to it) originate from the ammonia oxidation process that takes place at approximately 910°C and between 9.5 and 12 bar at the precious metal gauzes inside the plant's ammonia oxidation reactor.

The main product of this reaction is NO created by oxidising ammonia (NH<sub>3</sub>) with atmospheric oxygen (O<sub>2</sub>) (reaction 1). NO readily oxidises further to form NO<sub>2</sub> (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 NO<sub>2</sub> (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 N<sub>2</sub>O.

On leaving the ammonia oxidation reactor some of the N<sub>2</sub>O generated may decompose

- In the high temperature homogenous gas phase inside the ammonia oxidation reactor (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 reactor (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 plant downstream of the ammonia oxidation reactor, where temperatures above 300°C allow N<sub>2</sub>O to spontaneously decompose.

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

|                 | Source                                       | Gas              | Included?        | Justification / Explanation   |  |
|-----------------|--|------------------|------------------|---|--|
| <b>Baseline</b> | Nitric Acid Plant<br>(Burner Inlet to Stack) | CO <sub>2</sub>  | No               | The process does not lead to any CO <sub>2</sub> or CH <sub>4</sub> emissions |  |
|                 |  | CH <sub>4</sub>  | No               |   |  |
|                 |  | N <sub>2</sub> O | Yes              |   |  |
|                 |  |                  | CO <sub>2</sub>  |   |  |
|                 |  |                  | CH <sub>4</sub>  |   |  |
|                 |  |                  | N <sub>2</sub> O |   |  |
|                 |  |                  | CO <sub>2</sub>  |   |  |



|                  |  |                  |     |   |
|------------------|--|------------------|-----|---|
|                  |  | CH <sub>4</sub>  |     |   |
|                  |  | N <sub>2</sub> O |     |   |
| Project Activity | Nitric Acid Plant<br>(Burner Inlet to Stack) | CO <sub>2</sub>  | No  | The process does not lead to any CO <sub>2</sub> or CH <sub>4</sub> emissions |
|                  |  | CH <sub>4</sub>  | No  |   |
|                  |  | N <sub>2</sub> O | Yes |   |
|                  | Leakage emissions                            | CO <sub>2</sub>  | No  | No leakage emissions are expected.  |
|                  |  | CH <sub>4</sub>  | No  |   |
|                  |  | N <sub>2</sub> O | No  |   |

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

The approved baseline methodology AM0034 (Version 02) refers to AM0028 with regard to the identification of the baseline scenario. 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 activity (step 1), those that would not comply with applicable legal standards are eliminated (step2). After conducting a barrier analysis (step 3a), it is shown that at least one of the remaining scenario alternatives (which is not the project activity) is viable in spite of the identified barriers (step 3b). It will be demonstrated below that only one scenario alternative meets these criteria. This is the most likely “business as usual” scenario, the assumed baseline scenario.

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

The AM0028-procedure suggests assessing N<sub>2</sub>O and NO<sub>x</sub> abatement scenarios separately. This is omitted, because NO<sub>x</sub> abatement options are only relevant if the NO<sub>x</sub>– regulations in Israel would require an amendment of the plant. However, Haifa Chemicals is in compliance with Israel’s NO<sub>x</sub> regulations without any such technical amendment.

The baseline scenario alternatives should include all possible options that are technically feasible to handle N<sub>2</sub>O emissions. For the Haifa Chemicals plant, the principally debatable options are:

- 1) Status quo: The continuation of the current situation, without installing any N<sub>2</sub>O abatement technology in the plant
- 2) Alternative use of N<sub>2</sub>O such as:
  - a) recycling of N<sub>2</sub>O as feedstock for the plant;
  - b) The use of N<sub>2</sub>O for external purposes.
- 3) Installation of a Non-Selective Catalytic Reduction (NSCR) De NO<sub>x</sub> -unit<sup>4</sup>
- 4) Installation of an N<sub>2</sub>O abatement or reduction technology
  - a) Primary or tertiary measures to prevent the formation or reduce N<sub>2</sub>O

<sup>4</sup> NSCR: As a NSCR DeNO<sub>x</sub> -unit would reduce N<sub>2</sub>O emissions as a side reaction to the NO<sub>x</sub> -reduction, a new NSCR installation can be regarded as an alternative N<sub>2</sub>O reduction technology.



- b) A secondary facility to reduce N<sub>2</sub>O (proposed project activity)

These options should also include the CDM project activity not implemented as CDM project.

The use of N<sub>2</sub>O as a feedstock for the production of nitric acid is technically not feasible as it is not possible to produce nitric acid from N<sub>2</sub>O.

The use of N<sub>2</sub>O for external purposes 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 N<sub>2</sub>O concentration in the tail gas of Haifa Chemicals' N3 plant is during the baseline campaign was determined as being approximately 1,200 parts per million by volume on average, which is considered too low to economically recover and separate N<sub>2</sub>O from the tail gas.

Therefore, the baseline scenarios 2) 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. This step may also include laws and regulations that have another objective than GHG reduction, such as national or local NO<sub>x</sub> regulations.

There is no legal national, provincial or local government requirement for Haifa Chemicals to reduce NO<sub>x</sub> emissions below the current levels. The regulatory limit applicable to Haifa Chemical's South N3 plant of 500 mg/Nm<sup>3</sup> is specified in the operational permit (dated 11<sup>th</sup> May 1997).

Neither of Haifa Chemicals' nitric acid plants on this site (N3 and N4) has NO<sub>x</sub> abatement systems installed. Haifa Chemicals uses cooling water and brine for heat removal in the final stages of the NO<sub>2</sub> absorption process to reduce NO<sub>x</sub> emissions comfortably below the regulatory limit.

Therefore, it can be concluded that the continuation of the current situation or status quo is in full compliance with the current regulations.

The secondary abatement catalysts on the market have not shown to lead to any change in the levels of NO<sub>x</sub> emissions of the nitric acid plants where they were tested. Therefore, it can safely be assumed that Haifa Chemicals' NO<sub>x</sub> emissions will remain constant and in compliance after the installation of the secondary catalyst. In any case, NO<sub>x</sub> emissions are currently monitored by an NDIR analyser using extractive gas technology as installed for monitoring N<sub>2</sub>O concentration. Therefore, any change in NO<sub>x</sub> emission levels could easily be detected and investigated.

The above scenarios are in compliance with all 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).

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

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

The installation of a Non-Selective Catalytic Reduction (NSCR) De NO<sub>x</sub> unit is not economically viable since Haifa Chemicals is already in compliance with the prevailing NO<sub>x</sub> regulations. Should these NO<sub>x</sub> regulations change in a way that would require Haifa Chemicals to install a NO<sub>x</sub> 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<sub>x</sub> 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. Therefore, baseline scenario alternative 3) faces significant investment barriers.

None of the N<sub>2</sub>O 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 N<sub>2</sub>O abatement technology. Thus, any investment would be entirely voluntary.

Therefore, any baseline scenario alternatives that include the implementation of N<sub>2</sub>O abatement catalysts will entail considerable investment barriers.

### **Technical barriers**

Any of the available N<sub>2</sub>O abatement technologies are integrated in the nitric acid plant. Primary and secondary abatement technologies are installed inside the ammonia oxidation reactor where they may, if not correctly designed and installed, interfere with the nitric acid production process by causing a deterioration of product quality or a loss of production output. Tertiary measures require the installation of a complete 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).

Therefore, these circumstances also constitute considerable technical barriers.

### **Barriers due to prevailing practice**

The installation of N<sub>2</sub>O abatement technology currently is neither industrial practice in Israel nor anywhere else in the Middle East region. However, currently all nitric acid producers in the region (e.g. in Israel and Egypt) are pursuing the implementation of secondary or tertiary N<sub>2</sub>O abatement technologies in order to participate in the CDM. Thus, it can be assumed that these activities would not take place in the absence of CDM related revenues.

**Step 3b** demonstrates that the identified barriers would not prevent the implementation of at least one of the remaining alternatives (which is not the proposed project activity).

Under step 3a it was demonstrated that those baseline scenario alternatives entailing the installation of N<sub>2</sub>O abatement catalysts face considerable barriers.

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 baseline scenario 1): the continuation of the current situation without installing any N<sub>2</sub>O 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 section B.4.:



| Baseline Scenario Alternative                              | Legal / Technical preclusion | Identified barriers                    |            |                         | Probability |
|--|------------------------------|--|------------|-------------------------|-------------|
|  |                              | Investment related                     | Technical  | Common practice related |             |
| Continued plant operation without change                   | No                           | No                                     | No         | No                      | Likely      |
| External use of N <sub>2</sub> O                           | Yes (Technical)              | Irrelevant                             | Irrelevant | Irrelevant              | Excluded    |
| N <sub>2</sub> O re-cycling as feedstock for production    | Yes (Technical)              | Irrelevant                             | Irrelevant | Irrelevant              | Excluded    |
| Installation of a NSCR DeNO <sub>x</sub> unit              | No                           | Yes                                    | Yes        | Yes                     | Very Low    |
| Proposed project activity not implemented as a CDM project | No                           | Yes                                    | No         | Yes                     | Very Low    |
| 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 02) as agreed by the CDM Executive Board and published on 28th November 2005 (“Additionality Tool”).

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

**Steps 2 and 3:** To establish additionality, the Additionality Tool requires an investment or a barrier analysis, focussing on the comparison of the proposed project activity with the identified baseline scenario. Alternatively project applicants can select to do both.

Here, an investment analysis is chosen to carry out this part of the procedure. This corresponds with step 2 of the Additionality Tool; thus, step 3 (comprising the option of a barrier analysis) is omitted.

**Step 2: Investment Analysis**

**Step 2a:** At first, the appropriate investment evaluation methodology has to be chosen to conduct the comparative investment analysis between the identified baseline scenario and the proposed project activity.



As demonstrated above (B.4.), none of the two alternatives generates any additional financial or economic benefits besides those obtainable from the sale of CERs, which implies the applicability of a simple cost analysis. 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 N<sub>2</sub>O abatement catalyst and any necessary modifications of the basket 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 N<sub>2</sub>O abatement catalyst. The investment and operating costs for the Automated Monitoring System (AMS) amount to approximately EUR 80,000 (AMS purchasing price, 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 1.11 m over the course of the whole crediting period<sup>5</sup>. 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 N<sub>2</sub>O abatement catalyst – does not incur any additional costs. Therefore, the proposed project activity is financially and economically less attractive than the baseline scenario.

**(Step 3, Barrier Analysis is omitted, see above)**

#### **Step 4 Common Practice Analysis**

Step 4 assesses the common industrial practice in the area, where the project activity is to be implemented and thus allows verifying the results obtained in the previous steps. If the technology that is to be installed is the common industrial practice in the region already, this would indicate that the project activity is financially and economically more attractive than the baseline scenario alternative and / or that there are no considerable barriers for its implementation.

Market studies (e.g. by EFMA, EU IPPC, US EPA, IPCC) show that N<sub>2</sub>O abatement technologies have not yet spread out into the nitric acid industry even in Annex 1 countries, apart from occasional industrial testing. The main reason for this is a lack of regulation / incentive to reduce N<sub>2</sub>O 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 N<sub>2</sub>O emission caps. EU legislation initiating such a limit is under way already and will probably enter into force in 2007.

The proposed project activity would lead to a first time installation of N<sub>2</sub>O abatement technology for nitric acid plants in the region. Up until today, the common practice in the area is to operate such facilities without any N<sub>2</sub>O abatement technology. This situation is changing now, since other nitric acid plant operators are also planning to implement N<sub>2</sub>O abatement technologies as a CDM project activity.

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

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<sup>5</sup> More detailed, confidential information on investment and operation costs can be disclosed to the DOE and the CDM EB upon request



### Step 5: Impact of CDM registration

At step 5, it is to be demonstrated that the registration of the project activity as a CDM project can help to alleviate the economic and financial hurdles identified in Step 2 and thus enable the project activity to be undertaken.

As shown above, the proposed project activity will not generate any additional income other than CER-related revenues. Therefore, in order for Haifa Chemicals to carry out the project, it has to generate at least enough revenues from the sale of CERs in order to cover the costs of implementing and operating the project.

Assuming a conservative CER market value of EUR 6.00, the project is expected to generate CER related revenues of approximately EUR 8.64m throughout the crediting period. This is more than the expected investment and operating costs for the project over that time. Therefore, a CDM-registration would pave the way for the installation of a secondary N<sub>2</sub>O abatement catalyst at the Haifa Chemicals nitric acid plant in Mishor Rotem, Israel.

The financial benefit of the revenues obtainable from selling CERs will alleviate the economic and financial hurdles identified in Sub-step 2b above. Therefore, the registration as a CDM project activity and the resulting expected revenues from the sale of CERs will enable the management of Haifa Chemicals to commit to investing in the proposed project activity.

### Conclusion

Currently, there are no national regulations or legal obligations in Israel concerning N<sub>2</sub>O emissions. It is unlikely that any such limits on N<sub>2</sub>O emissions will be imposed in the near future.

Haifa Chemicals is in no need to invest in any N<sub>2</sub>O 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.

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| <b>B.6. Emission reductions:</b> |
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| <b>B.6.1. Explanation of methodological choices:</b> |
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#### **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 N<sub>2</sub>O 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)
- 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 (tNH<sub>3</sub>/h)
- AFRmax Maximum ammonia gas flow rate to the AOR (tNH<sub>3</sub>/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 OTh, OPh, AFR and AIFR were recorded by the process control system for the previous 10 campaigns and analysed by using the hourly average values.

**2. Determination of baseline emission factor: measurement procedure for N<sub>2</sub>O concentration and gas volume flow**

N<sub>2</sub>O concentration and gas volume flow are to be monitored throughout the baseline campaign by an Automated Monitoring System (AMS) which is to be installed and operated using European Norm 14181 (2004) as guidance where applicable. The AMS provides separate readings for N<sub>2</sub>O 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 N<sub>2</sub>O 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:

- 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 (volume of stack gas (VSG) and N<sub>2</sub>O concentration of stack gas (NCSG))

The average mass of N<sub>2</sub>O emissions per hour is estimated as product of the NCSG and VSG. The N<sub>2</sub>O emissions per campaign are estimates product of N<sub>2</sub>O 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 N<sub>2</sub>O emissions per tonne of nitric acid over one full campaign is derived by dividing the total mass of N<sub>2</sub>O 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 N<sub>2</sub>O 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  $N_2O$  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. At N3, campaign no. 350 was terminated prematurely due to technical problems at the plant. Therefore campaign no. 350 is considered an abnormal campaign and was eliminated from this analysis.

**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 OTh, OPh, 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<sub>2</sub>O 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 N<sub>2</sub>O 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<sub>ma,n</sub>, 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<sub>ma,n</sub> and EF<sub>n</sub> shall be applied as the emission factor relevant for the particular campaign to be used to calculate emissions reduction s (EF<sub>p</sub>). 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

N<sub>2</sub>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<sub>n</sub> observed during those campaigns will be adopted as a minimum (EF<sub>min</sub>). EF<sub>min</sub> is equal to the lowest EF<sub>n</sub> observed during the first 10 campaigns of the project crediting period (N<sub>2</sub>O/tHNO<sub>3</sub>). If any of the later project campaigns results in a EF<sub>n</sub> that is lower than EF<sub>min</sub>, the calculation of the emission reductions for that particular campaign shall use EF<sub>min</sub> and not EF<sub>n</sub>.

#### Project Campaign Length

If the length of each individual project campaign CL<sub>n</sub> is longer than or equal to the average historic campaign length CL<sub>normal</sub>, then all N<sub>2</sub>O 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<sub>n</sub> < CL<sub>normal</sub>, recalculate EF<sub>BL</sub> by eliminating those N<sub>2</sub>O values that were obtained during the production of tonnes of nitric acid beyond the CL<sub>n</sub> (i.e. the last tonnes produced) from the calculation of EF<sub>n</sub>.

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 N<sub>2</sub>O:

$$ER = (EF_{BL} - EF_P) * NAP * GWP_{N_2O}$$

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 production capacity is 94,900 metric tonnes of 100% concentrated nitric acid per year (based on 365<sup>6</sup> operating days per year and a daily nameplate capacity of 260 t/d tonnes of nitric acid). Therefore, the N3 nitric acid plant shall not be eligible to earn CERs for any tonnes of nitric acid produced exceeding 94,900 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 N3 nitric acid plant is 240 t/day and it normally operates for approximately 330 days per year, so it is not to be expected that the plant exceeds the design capacity for the purposes of this project.

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| <b>B.6.2. Data and parameters that are available at validation:</b> |
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|---|---|
| <b>Data / Parameter:</b>  | <b>B.1 / NCSG<sub>BC</sub></b>  |
| Data unit:  | mg/Nm <sup>3</sup>  |
| Description:  | N <sub>2</sub> O concentration in the stack gas during the baseline campaign.   |
| Source of data used:  | NDIR N <sub>2</sub> O gas analyser (ABB AO2000-Uras14)  |
| Value applied:  | 2,378.76  |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | AM0034 requires the determination of the concentration of N <sub>2</sub> O in the stack gas. NCSG is continuously monitored with an NDIR gas analyser <sup>7</sup> 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:<br>a) Calculate the sample mean (x)<br>b) Calculate the sample standard deviation (s)<br>c) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation)<br>d) Eliminate all data that lie outside the 95% confidence interval<br>e) Calculate the new sample mean from the remaining NCSG values |
| Any comment:  | None  |

<sup>6</sup> As per AM0034 page 11.

<sup>7</sup> The ABB AO2000 Uras 14 has been certified by TÜV Süddeutschland in accordance with the German 27<sup>th</sup> 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 N<sub>2</sub>O measurements under QAL1 of ISO14956. A QAL1 certified analyser was not available at the time of purchase by Haifa Chemicals.



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| <b>Data / Parameter:</b>  | <b>B.2 VSG<sub>BC</sub></b>   |
| Data unit:  | Nm <sup>3</sup> /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:  | 30,538.64   |
| Justification of the choice of data or description of measurement methods and procedures actually 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. VSG data taken during times when the plant was operating outside the permitted operating range were eliminated.</p> <p>The resulting hourly average VSG values are now expressed in Nm<sup>3</sup>/h as required by AM0034 and where subsequently subjected to the following statistical analysis:</p> <ol style="list-style-type: none"> <li>Calculate the sample mean (x)</li> <li>Calculate the sample standard deviation (s)</li> <li>Calculate the 95% confidence interval (equal to 1.96 times the standard deviation)</li> <li>Eliminate all data that lie outside the 95% confidence interval</li> <li>e) Calculate the new sample mean from the remaining VSG values</li> </ol> |
| Any comment:  | None  |

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|---|---|
| <b>Data / Parameter:</b>  | <b>B.3 BE<sub>BC</sub></b>  |
| Data unit:  | tN <sub>2</sub> O   |
| Description:  | Total N <sub>2</sub> O gas flow for baseline campaign   |
| Source of data used:  | Calculation from measured data.   |
| Value applied:  | 128.36  |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | <p>The total mass N<sub>2</sub>O 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  |

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|---|---|
| <b>Data / Parameter:</b>  | <b>B.4 OH<sub>BC</sub></b>  |
| Data unit:  | hours   |
| Description:  | Operating hours   |
| Source of data used:  | Process Control System.   |
| Value applied:  | 1,767   |
| 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 N<sub>2</sub>O during the baseline.</p> <p>As per the operational procedures of N3, the plant is considered to be offline if</p> |



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| ment methods and procedures actually applied : | 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.<br><br>As a result, 14 hours were excluded from the original time data series (after reduction of $CL_{BL}$ to be the same as $CL_{normal}$ ). |
| Any comment:                                   | None   |

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| <b>Data / Parameter:</b>  | <b>B.5 NAP<sub>BC</sub></b>  |
| Data unit:  | tHNO <sub>3</sub>  |
| Description:  | Metric tonnes of 100% concentrated nitric acid produced during the baseline campaign.  |
| Source of data used:  | Coriolis mass flow meter   |
| Value applied:  | 17,256.75  |
| Justification of the choice of data or description of measurement methods and procedures actually 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.<br><br>NAP is measured with a Coriolis mass flow meter. |
| Any comment:  | None   |

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| <b>Data / Parameter:</b>  | <b>B.6 TSG</b>   |
| 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   |

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| <b>Data / Parameter:</b>   | <b>B.7 PSG</b>   |
| 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 pro- | 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. |



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| cedures actually applied : |      |
| Any comment:               | None |

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| <b>Data / Parameter:</b>  | <b>B.8 EF<sub>BL</sub></b>   |
| Data unit:  | tN <sub>2</sub> O / tHNO <sub>3</sub>  |
| Description:  | Emissions factor for baseline period   |
| Source of data used:  | Calculated from measured data (tons of nitric acid produced / tons of N <sub>2</sub> O emitted)  |
| Value applied:  | 0.00733  |
| 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 <sub>2</sub> O emissions per tonne of nitric acid during the baseline campaign is derived by dividing the total mass of N <sub>2</sub> 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 <sub>2</sub> O emission factor per tonne of nitric acid produced in the baseline period (EF <sub>BL</sub> ) is then reduced by the percentage uncertainty as follows:<br><br>$EF_{BL} = (BE_{BC} / NAP_{BC}) (1 - UNC/100) (tN_2O/tHNO_3)$ |
| Any comment:  | None   |

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| <b>Data / Parameter:</b>  | <b>B.9 UNC</b>   |
| 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:  | 1.426  |
| 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 <sub>BL</sub> ).<br><br><ol style="list-style-type: none"> <li>1. The Uras 14 ABB Analyzer accuracy is 1.0% of the range as certified by ABB on 31.01.2006</li> <li>2. The compression deviation of Analyzer PI Tag (PI is the data acquisition system) is 0.1% of span</li> <li>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.</li> <li>4. The compression deviation of Rosemount Flow meter PI Tag is 0.125% of span</li> <li>5. Analogue input DCS Foxboro card (FBM01 ANALOG INPUT MODULE) accuracy is +-0.05% of span</li> </ol> <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.  |



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| <b>Data / Parameter:</b>  | <b>B.10 AFR</b>  |
| Data unit:  | tNH <sub>3</sub> /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 <sub>max</sub> . |
| 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 <sub>max</sub> .                                 |
| Any comment:  | None   |

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|---|---|
| <b>Data / Parameter:</b>  | <b>B.11 AFR<sub>max</sub></b>   |
| Data unit:  | tNH <sub>3</sub> /h   |
| Description:  | Maximum Ammonia gas flow rate to the ammonia oxidation reactor  |
| Source of data used:  | AFR data from previous campaigns  |
| Value applied:  | 3,267.3   |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | AFR <sub>max</sub> 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  |

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| <b>Data / Parameter:</b>  | <b>B.12 AIFR</b>  |
| 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 <sub>max</sub> .  |
| 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 <sub>max</sub> . The permitted range for the NH <sub>3</sub> to Air ratio is taken from the data of the historic campaigns.<br><br>Primary Air flow is measured with a venturi dP flow meter. |
| Any comment:  | None  |



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| <b>Data / Parameter:</b>  | <b>B.15 AIFR<sub>max</sub></b>   |
| 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:  | 13.0   |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | <p>In accordance with AM0034 AIFR<sub>max</sub> is used to determine those periods where the plant may be operating outside of the permitted operating conditions. AIFR<sub>max</sub> is derived from the maximum value observed from the data series of AIFR, which in the case of N3 was 13.19.</p> <p>However, this is considered to be above the the “trip value” of 13.0 above which the plant would normally shut down. Therefore, the value of 13.0 is applied as AIFR<sub>max</sub>.</p> |
| Any comment:  | None   |

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| <b>Data / Parameter:</b>  | <b>B.13 CL<sub>BL</sub></b>  |
| Data unit:  | tHNO <sub>3</sub>  |
| 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 <sub>BC</sub>  |
| Value applied:  | 17,256.75  |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | <p>CL<sub>BL</sub> 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<sub>BL</sub> is then compared with CL<sub>normal</sub>. The actual total number of tonnes of nitric acid produced during CL<sub>BL</sub> was 17,570.99 which is 269.29 tonnes of nitric acid ‘longer’ than CL<sub>normal</sub>, therefore, the time data series of CL<sub>BL</sub> was cut by the last few hours of measurements until the NAP value for CL<sub>BL</sub> was below CL<sub>normal</sub>. Since only NAP measurements for full hours are available, the CL<sub>BL</sub> was shortened to 17,256.75 tonnes of nitric acid instead of the exact 17,301.7 tonnes given by CL<sub>normal</sub>.</p> |
| Any comment:  | None   |

|   |  |
|---|--|
| <b>Data / Parameter:</b>  | <b>B.14 CL<sub>normal</sub></b>  |
| Data unit:  | tHNO <sub>3</sub>  |
| 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:  | 17,301.7   |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | In accordance with AM0034 the average historic campaign length (CL <sub>normal</sub> ) is defined as the average campaign length for the historic campaigns that were used to define operating condition. CL <sub>normal</sub> presents the cap on the length of the |





|  |   |
|--|---|
| ment methods and procedures actually applied : | <p>baseline campaign from which the baseline emissions factor will be derived.</p> <p>The baseline campaign length (<math>CL_{BL}</math>) has to be compared to the established average historic campaign length (<math>CL_{normal}</math>) and if it is found that</p> <ul style="list-style-type: none"> <li>- <math>CL_{BL} \leq CL_{normal}</math>, then all <math>N_2O</math> values measured during the baseline campaign can be used for the calculation of <math>EF_{BL}</math> (subject to the elimination of data that was monitored during times where the plant was operating outside of the “permitted range”).</li> <li>- <math>CL_{BL} &gt; CL_{normal}</math>, then <math>N_2O</math> values that were measured beyond the length of <math>CL_{normal}</math> during the production of the quantity of nitric acid (i.e. the final tonnes produced) are to be eliminated from the calculation of <math>EF_{BL}</math>.</li> </ul> <p>During the five historic campaigns, a total of 86,508.52 metric tonnes of 100% concentrated nitric acid have been produced, resulting in an average production output (NAP) of 17,301.7 per campaign. This value represents the average historic campaign length (<math>CL_{normal}</math>).</p> |
| Any comment:                                   | None.   |

|   |   |
|---|---|
| <b>Data / Parameter:</b>  | <b>B.16 OT<sub>h</sub></b>  |
| 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 : | <p>In accordance with AM0034 the oxidation temperature in the ammonia oxidation reactor (OT<sub>h</sub>) has to be monitored and compared to the Normal range for oxidation temperature (OT<sub>normal</sub>).</p> <p>VSG and NCSG data obtained during times when OT<sub>h</sub> was above or below OT<sub>normal</sub> has to be eliminated from the calculation of <math>EF_{BL}</math>.</p> |
| Any comment:  | None  |

|   |   |
|---|---|
| <b>Data / Parameter:</b>  | <b>B.17 OT<sub>normal</sub></b>   |
| Data unit:  | °C (min and max)  |
| Description:  | Normal range operating temperature  |
| Source of data used:  | Measurements from thermocouples during historical campaigns   |
| Value applied:  | 874.51°C (min.) and 917.86°C (max.)   |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | <p>AM0034 requires the establishment of the normal range of operating temperatures in the ammonia oxidation reactor (AOR).</p> <p>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</p> |



|              |   |
|--------------|---|
|              | maximum and minimum normal operating temperatures in the AOR. |
| Any comment: | None  |

|   |  |
|---|--|
| <b>Data / Parameter:</b>  | <b>B.18 OP<sub>h</sub></b>   |
| 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 : | <p>In accordance with AM0034 the oxidation pressure in the ammonia oxidation reactor (OP<sub>h</sub>) has to be monitored and compared to the Normal range for oxidation temperature (OP<sub>normal</sub>). VSG and NCSG data obtained during times when OP<sub>h</sub> was above or below OP<sub>normal</sub> has to be eliminated from the calculation of EF<sub>BL</sub>.</p> <p>AM0034 prescribes the monitoring and recording of the Oxidation Pressure for each hour (OP<sub>h</sub>) 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 OP<sub>h</sub> between these campaigns.</p> |
| Any comment:  | None   |

|   |  |
|---|--|
| <b>Data / Parameter:</b>  | <b>B.19 OP<sub>normal</sub></b>  |
| 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:  | 9.69 bar to 11.58 bar  |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | <p>AM0034 requires the establishment of the normal range of operating pressure in the ammonia oxidation reactor.</p> <p>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.</p> |
| Any comment:  | None   |

|                          |  |
|--------------------------|--|
| <b>Data / Parameter:</b> | <b>B.20 GS<sub>normal</sub></b>                      |
| Data unit:               | Name of Supplier                                     |
| Description:             | Gauze supplier for the operating condition campaigns |
| Source of data used:     | Monitored / Invoices                                 |



|   |  |
|---|--|
| Value applied:  | W.C. Heraeus   |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | <p>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.</p> <p>Haifa Chemicals has been using ammonia oxidation catalyst gauzes supplied by Heraeus for the past several years in N3 and N4 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.</p> <p>However, by deciding on using the N<sub>2</sub>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<sup>®</sup> RN20/101 catalyst system. Therefore, the GS<sub>project</sub> will be Johnson Matthey plc for the foreseeable future.</p> <p>The value for GS<sub>normal</sub> is only a plausibility check, the decisive value in determining if the baseline campaign data is applicable is the comparison of GC<sub>normal</sub> and GC<sub>BL</sub>.</p> |
| Any comment:  | None   |

|   |   |
|---|---|
| <b>Data / Parameter:</b>  | <b>B.21 GS<sub>BL</sub></b>   |
| Data unit:  | Name of Supplier  |
| Description:  | Gauze supplier for the operating condition campaigns  |
| Source of data used:  | Monitored / Invoices  |
| Value applied:  | W.C. Heraeus  |
| 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  |

|   |  |
|---|--|
| <b>Data / Parameter:</b>  | <b>B.23 GC<sub>normal</sub></b>  |
| 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%<br>Rhodium (Rh) 5.0%<br>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 |



|  |   |
|--|---|
| ment methods and procedures actually applied : | (previous five campaigns), then there shall be no limitations on N <sub>2</sub> O baseline emissions. |
| Any comment:                                   | None  |

|   |   |
|---|---|
| <b>Data / Parameter:</b>  | <b>B.24 GC<sub>BL</sub></b>   |
| 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%<br>Rhodium (Rh) 5.0%<br>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 N<sub>2</sub>O baseline emissions if the following conditions are met</p> <ol style="list-style-type: none"> <li>The baseline catalyst composition is considered as common practice in the industry, or</li> <li>The change in catalyst composition is justified by its availability, performance, relevant literature etc.</li> </ol> <p>Otherwise, the baseline emission factor shall be set to the conservative IPCC default emission factor for N<sub>2</sub>O from nitric acid plants which have not installed N<sub>2</sub>O destruction measures (4.5 kg-N<sub>2</sub>O / t HNO<sub>3</sub>).</p> <p>GC<sub>BL</sub> at Haifa Chemicals' N3 nitric acid plant is the same as GC<sub>normal</sub>, therefore, the results of the baseline campaign are fully valid and applicable.</p> |
| Any comment:  | None  |

|   |   |
|---|---|
| <b>Data / Parameter:</b>  | <b>B.26 EF<sub>reg</sub></b>  |
| Data unit:  | tN <sub>2</sub> O/tHNO <sub>3</sub>   |
| Description:  | Emissions cap for N <sub>2</sub> 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 <sub>2</sub> 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 plant's data acquisition system into a dedicated relational database management system ("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    | Unique identifier for the project      |
| ProjName    | Text       | Short name of the project              |
| ProjOwner   | Text       | Operator of the installation           |
| ProjLoc     | Text       | Location of the installation (City)    |
| ProjCountry | Text       | Location of the installation (Country) |

Sample content of table PROJECTS

| Projects |          |                 |         |             |
|----------|----------|-----------------|---------|-------------|
| ProjId   | ProjName | ProjOwner       | ProjLoc | 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  |

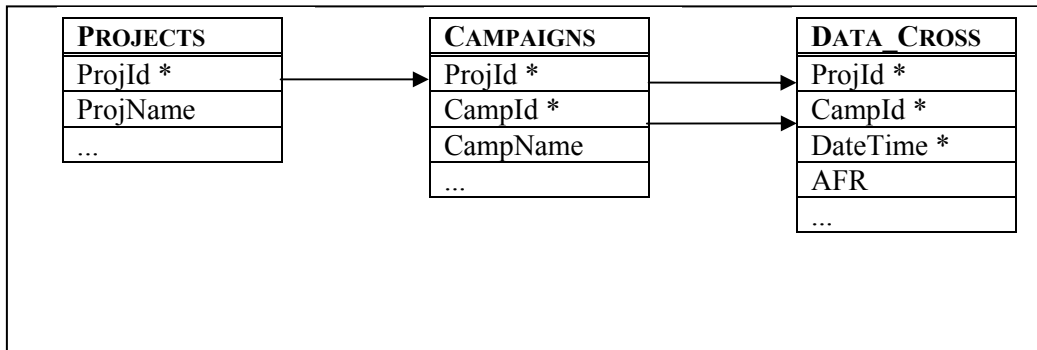
Finally, the times series of the parameter values listed above are stored in table DATA\_CROSS. Each set of values for the different parameters is identified by the ProjId, CampId and a date/time-stamp.

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 1<sup>8</sup>:

- Number of data sets
- Minimum value
- Maximum value
- 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 somewhat difficult to read and is, therefore, exported into an Excel spreadsheet for further analysis.

Resulting Access table of Query 1

| ProjId | CampType | Count(DT) | Count(AFR) | Min(AFR) | Max(AFR) | Avg(AFR) | StdDev(AFR) | Count(AIFR) |
|--------|----------|-----------|------------|----------|----------|----------|-------------|-------------|
| 4      | B        | 1.842,00  | 1.842,00   | 0,00     | 3.267,32 | 2.988,15 | 246,20      | 1.842,00    |
| 4      | H        | 10.513,00 | 10.512,00  | 0,00     | 3.279,11 | 2.498,72 | 729,16      | 10.391,00   |
| 4      | X        | 7.539,00  | 7.498,00   | 0,00     | 3.444,84 | 2.718,35 | 840,17      | 7.496,00    |

The table shown above is reorganised into the sheet shown below to enhance clarity and convenience.

<sup>8</sup> All queries are available and can be provided to the DOE upon request.



| N.DBMS Baseline Calculation  |       |                            |             |       |       |          |          |             |
|------------------------------|-------|----------------------------|-------------|-------|-------|----------|----------|-------------|
| Project:                     |       | Haifa Chemicals N3         |             |       |       |          |          |             |
|                              | OH    | AFR                        | AIFR        | Oph   | OTh   | NCSG     | VSG      | NAP         |
| Historical campaigns         |       | Historic Query 1: raw data |             |       |       |          |          |             |
|                              | h     | kg NH3 / h                 | kmol / kmol | bar-g | oC    | mg / Nm3 | Nm3 / h  | kg HNO3 / h |
| Count                        | 9,971 | 9,971                      | 9,969       | 9,971 | 9,969 |          |          |             |
| Remaining share of data sets |       |                            |             |       |       |          |          |             |
| Minimum                      |       | 0                          | 0           | 0     | 100   |          |          |             |
| Maximum                      |       | 3,267                      | 979         | 12    | 921   |          |          |             |
| Mean                         |       | 2,606                      | 0           | 10    | 862   |          |          |             |
| Standard deviation           |       | 653                        | 10          | 2     | 166   |          |          |             |
| Sum                          |       |                            |             |       |       |          |          | 86,508,524  |
|                              |       |                            |             |       |       |          | Avg. NAP | 17,301,705  |

Next, the 2.5% percentiles for OTh and OPh are excluded 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.

| N.DBMS Baseline Calculation             |       |   |             |       |        |          |         |             |
|---|-------|---|-------------|-------|--------|----------|---------|-------------|
| Project:                                |       | Haifa Chemicals N3  |             |       |        |          |         |             |
|   | OH    | AFR   | AIFR        | Oph   | OTh    | NCSG     | VSG     | NAP         |
| Historical campaigns                    |       | Historic Query 2: exclusion of data from 2.5% percentiles |             |       |        |          |         |             |
|   | h     | kg NH3 / h  | kmol / kmol | bar-g | oC     | mg / Nm3 | Nm3 / h | kg HNO3 / h |
| Count                                   | 7,828 | 7,828   | 7,828       | 7,828 | 7,828  |          |         |             |
| Remaining share of data sets            | 79%   | 79%   | 79%         | 79%   | 79%    |          |         |             |
| Minimum                                 |       | 1,901   | 0.09        | 9.5   | 874    |          |         |             |
| Maximum                                 |       | 3,267.3   | 0.1319      | 11.7  | 918    |          |         |             |
| Mean                                    |       | 2,734   | 0.10        | 10.5  | 900    |          |         |             |
| Standard deviation                      |       | 278   | 0.00        | 0.5   | 12     |          |         |             |
| Sum                                     |       |   |             |       |        |          |         | 71,467,470  |
| <i>Limits acc. to consistency check</i> |       |   |             |       |        |          |         |             |
| Lower limit                             |       |   |             | 9.50  | 874.30 |          |         |             |
| Upper limit                             |       |   |             | 11.67 | 918.23 |          |         |             |

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.





## Query 1: determination of OH and NAP

| N.DBMS Baseline Calculation               |                    |            |                             |       |       |                          |         |             |
|---|--------------------|------------|-----------------------------|-------|-------|--------------------------|---------|-------------|
| Project:                                  | Haifa Chemicals N3 |            |                             |       |       |                          |         |             |
| Baseline campaign                         | OH                 | AFR        | AIFR                        | Oph   | OTh   | NCSG                     | VSG     | NAP         |
| <b>Query 1: excluding data &lt; 750°C</b> |                    |            |                             |       |       |                          |         |             |
|   | h                  | kg NH3 / h | kmol / kmol                 | bar-g | oC    | mg / Nm3                 | Nm3 / h | kg HNO3 / h |
| Count                                     | 1,767              | 1,766      | 1,767                       | 1,766 | 1,767 | 1,766                    | 1,766   |             |
| Remaining share of data sets              |                    |            |                             |       |       |                          |         |             |
| Minimum                                   |                    | 1,559      | 0.09                        | 6     | 806.9 | 1,920                    | 17,540  |             |
| Maximum                                   |                    | 3,077      | 0.11                        | 12    | 920.6 | 3,970                    | 34,407  |             |
| Mean                                      |                    | 2,891      | 0.10                        | 11    | 915.7 | 2,340                    | 30,506  |             |
| Standard deviation                        |                    | 106        | 0.00                        | 0     | 5     | 140                      | 766     |             |
| Sum                                       |                    |            |                             |       |       |                          |         | 17,256,751  |
| Permitted range acc. to AM0034            |                    |            |                             |       |       |                          |         |             |
| Lower limit                               |                    |            |                             |       | 750   |                          |         |             |
| Upper limit                               |                    |            |                             |       |       |                          |         |             |
| Baseline emissions                        | BE                 |            |                             |       |       |                          |         | 126         |
| Emission factor                           | EF                 |            | $VSG * NCSG * 10^{-6} * Oh$ |       |       | t N2O<br>kg N2O / t HNO3 |         | 7.31        |
| Uncertainty                               |                    |            |                             |       |       |                          |         |             |

According to this Query 1, the OH value of the baseline campaign is 1,767 hours and the NAP value is 17,256.7 tonnes of nitric acid.

Query 2: Applying the normal operating range from historical data<sup>9</sup>

| N.DBMS Baseline Calculation  |                    |            |                             |       |        |                          |         |             |
|--|--------------------|------------|-----------------------------|-------|--------|--------------------------|---------|-------------|
| Project:   | Haifa Chemicals N3 |            |                             |       |        |                          |         |             |
| Baseline campaign  | OH                 | AFR        | AIFR                        | Oph   | OTh    | NCSG                     | VSG     | NAP         |
| <b>Query 2: applying normal operating range from historic data</b> |                    |            |                             |       |        |                          |         |             |
|  | h                  | kg NH3 / h | kmol / kmol                 | bar-g | oC     | mg / Nm3                 | Nm3 / h | kg HNO3 / h |
| Count  | 1,382              | 1,382      | 1,382                       | 1,382 | 1,382  | 1,382                    | 1,382   |             |
| Remaining share of data sets                                       | 78%                |            | 78%                         | 78%   | 78%    | 78%                      | 78%     |             |
| Minimum  |                    | 2,292      | 0.10                        | 9.9   | 889.1  | 2,016                    | 28,706  |             |
| Maximum  |                    | 3,070      | 0.11                        | 11.6  | 917.8  | 2,997                    | 34,407  |             |
| Mean   |                    | 2,886      | 0.10                        | 11    | 915    | 2,384                    | 30,592  |             |
| Standard deviation   |                    | 101        | 0.00                        | 0.2   | 4      | 93                       | 659     |             |
| Sum  |                    |            |                             |       |        |                          |         | 13,499,324  |
| Permitted range acc. to AM0034                                     |                    |            |                             |       |        |                          |         |             |
| Lower limit  |                    |            |                             | 9.69  | 874.51 |                          |         |             |
| Upper limit  |                    | 3,267      | 0.13                        | 11.58 | 917.86 |                          |         |             |
| Baseline emissions   | BE                 |            |                             |       |        |                          |         | 129         |
| Emission factor  | EF                 |            | $VSG * NCSG * 10^{-6} * Oh$ |       |        | t N2O<br>kg N2O / t HNO3 |         | 7.47        |
| Uncertainty  |                    |            |                             |       |        |                          |         |             |

<sup>9</sup> Note that the normal operating range used in the Historic Query 2 differs from the normal operating range applied here. Initially the normal operating range was established using 10 historic campaigns, this range was applied in the historic query. In accordance with AM0034, the normal operating range for the baseline campaign was derived using 5 historic campaigns, which was then applied in this Baseline Query 2. The values are only slightly different and there is no effect on the resulting EF<sub>BL</sub>.

Query 3: Application of 95% confidence interval and calculation of  $EF_{BL}$ 

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.

| N.DBMS Baseline Calculation                  |            |                              |             |       |        |                 |           |               |
|--|------------|------------------------------|-------------|-------|--------|-----------------|-----------|---------------|
| Project:                                     |            | Haifa Chemicals N3           |             |       |        |                 |           |               |
| Baseline campaign                            | OH         | AFR                          | AIFR        | Oph   | OTh    | NCSG            | VSG       | NAP           |
| <b>Query 3: applying confidence interval</b> |            |                              |             |       |        |                 |           |               |
|  | h          | kg NH3 / h                   | kmol / kmol | bar-g | oC     | mg / Nm3        | Nm3 / h   | kg HNO3 / h   |
| Count  | 1,282      | 1,282                        | 1,282       | 1,282 | 1,282  | 1,282           | 1,282     |               |
| Remaining share of data sets                 | 73%        | 73%                          | 73%         | 73%   | 73%    | 73%             | 73%       |               |
| Minimum                                      |            | 2,292                        | 0.10        | 10.0  | 889    | 2,205           | 29,299    |               |
| Maximum                                      |            | 3,030                        | 0.11        | 11.3  | 918    | 2,561           | 31,666    |               |
| Mean   |            | 2,900                        | 0           | 11    | 916    | 2,378.76        | 30,538.64 |               |
| Standard deviation                           |            | 55                           | 0.00        | 0.2   | 2      | 62              | 458       |               |
| Sum  |            |                              |             |       |        |                 |           | 12,588,259    |
| <i>Permitted range acc. to AM0034</i>        |            |                              |             |       |        |                 |           |               |
| Lower limit                                  |            |                              |             | 9.69  | 874.51 | 2,202           | 29,301    |               |
| Upper limit                                  |            | 0                            | 0.00        | 11.58 | 917.86 | 2,565           | 31,884    |               |
| <b>Baseline emissions</b>                    | <b>BE</b>  | $VSG * NCSG * 10^{-6} * Oh$  |             |       |        | t N2O           |           | <b>128.36</b> |
| <b>Emission factor</b>                       | <b>EF</b>  | $(BE / NAP) * (1 - UNC/100)$ |             |       |        | kg N2O / t HNO3 |           | <b>7.33</b>   |
| <b>Uncertainty</b>                           | <b>UNC</b> |                              |             |       |        | %               |           | 1.426         |

The values appearing in green in the above Query 3 result table indicate that the values during the BL campaign were within 1.96 times the standard deviation of the mean values from the historic 5 campaigns. Therefore, it can be concluded that the baseline is representative of a normal campaign.

The line “Remaining share of data sets” in the excel table indicates how many data sets remain after application of the queries. Since this value is well above the 50% required by AM0034, the baseline is valid.

Also, the determined uncertainty for the AMS is applied to the EF calculation.

The resulting baseline emissions factor is 7.33 kgN<sub>2</sub>O/tHNO<sub>3</sub>.

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 being 79,200 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<sub>2</sub>O abatement catalyst, which is assumed to be at least 80% of baseline N<sub>2</sub>O emissions. Taking  $EF_{BL}$  of 7.33 kgN<sub>2</sub>O/tHNO<sub>3</sub> and applying 80% abatement efficiency, the annual baseline emissions would be 180,023 tCO<sub>2</sub>E and the annual emission reductions 144,018 tCO<sub>2</sub>E.
- Project start on 28 Feb., 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 <sub>2</sub> e) | Estimation of baseline emissions (tonnes of CO <sub>2</sub> e) | Estimation of leakage (tonnes of CO <sub>2</sub> e) | Estimation of overall emission reductions (tonnes of CO <sub>2</sub> e) |
|--------------|--|--|---|---|
| 2007         | 30,004   | 150,019  | 0   | 120,015   |
| 2008         | 36,005   | 180,023  | 0   | 144,018   |
| 2009         | 36,005   | 180,023  | 0   | 144,018   |
| 2010         | 36,005   | 180,023  | 0   | 144,018   |
| 2011         | 36,005   | 180,023  | 0   | 144,018   |
| 2012         | 36,005   | 180,023  | 0   | 144,018   |
| 2013         | 36,005   | 180,023  | 0   | 144,018   |
| 2014         | 36,005   | 180,023  | 0   | 144,018   |
| 2015         | 36,005   | 180,023  | 0   | 144,018   |
| 2016         | 36,005   | 180,023  | 0   | 144,018   |
| 2017         | 6,001  | 30,004   | 0   | 24,003  |
| <b>Total</b> | <b>360,050</b>   | <b>1,800,230</b>   | <b>0</b>  | <b>1,440,180</b>  |

**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.

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>Data / Parameter:</b>   | <b>P.1 NCSG</b>   |
|--|---|
| Data unit:   | ppmv (convertible to mg N <sub>2</sub> O / m <sup>3</sup> )   |
| Description:   | N <sub>2</sub> O concentration in the stack gas during each project campaign.   |
| Source of data to be used:   | NDIR N <sub>2</sub> 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 <sub>2</sub> O in the stack gas. NCSG is continuously monitored with an NDIR gas analyser <sup>10</sup> 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 |

<sup>10</sup> The Environnement S.A. MIR 9000 gas analyser has been certified according to ISO 14956, QAL 1 procedures as suitable for stack gas concentration monitoring of NO, NO<sub>2</sub>, SO<sub>2</sub> and various other gasses. At the time of installation of the AMS at Haifa Chemicals's N3 plant, no analyser was available on the market that had already passed the certification for N<sub>2</sub>O.



|                                 |  |
|---------------------------------|--|
|                                 | 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:<br>a) Calculate the sample mean (x)<br>b) Calculate the sample standard deviation (s)<br>c) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation)<br>d) Eliminate all data that lie outside the 95% confidence interval<br>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   |

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|--|---|
| <b>Data / Parameter:</b>   | <b>P.2 VSG</b>  |
| Data unit:   | Nm <sup>3</sup> /h  |
| Description:   | Normal gas volume flow rate of the stack gas during each project campaign.  |
| Source of data to be used:   | Gas Volume Flow meter, Emerson Rosemount Annubar® Model 3095 NFA  |
| 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 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).<br><br>VSG data taken during times when the plant was operating outside the permitted operating range are to be eliminated.<br><br>The resulting hourly average VSG values are now expressed in Nm <sup>3</sup> /h as required by AM0034 and where subsequently subjected to the following statistical analysis:<br>a) Calculate the sample mean (x)<br>b) Calculate the sample standard deviation (s)<br>c) Calculate the 95% confidence interval (equal to 1.96 times the standard deviation)<br>d) Eliminate all data that lie outside the 95% confidence interval<br>e) 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.   |



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| <b>Data / Parameter:</b>   | <b>P.3 PE<sub>n</sub></b>  |
| Data unit:   | tN <sub>2</sub> O  |
| Description:   | Total mass N <sub>2</sub> 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:                                 | Not applicable, calculated value as per the following formula:<br>$PE_n = VSG * NCSG * 10^{-9} * OH$ |
| QA/QC procedures to be applied:  | Not applicable. Calculated value.  |
| Any comment:   | None.  |

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|--|---|
| <b>Data / Parameter:</b>   | <b>P.4 OH<sub>n</sub></b>   |
| 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 <sub>2</sub> O during the baseline.<br>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.   |

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|---|--|
| <b>Data / Parameter:</b>  | <b>P.5 NAP</b>   |
| Data unit:  | tHNO <sub>3</sub>  |
| 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 emis- | Not available yet.   |



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| sion reductions in section B.5                                   |  |
| 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.<br>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:   |  |

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|--|---|
| <b>Data / Parameter:</b>   | <b>P.6 TSG</b>  |
| 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 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 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.   |

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| <b>Data / Parameter:</b>   | <b>P.7 PSG</b>   |
| 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.   |



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| Any comment: | None. |
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| <b>Data / Parameter:</b>   | <b>P.8 EF<sub>n</sub></b>  |
| Data unit:   | tN <sub>2</sub> O/tHNO <sub>3</sub>  |
| Description:   | Emissions factor for campaign n.   |
| Source of data to be used:   | Calculation from total mass N <sub>2</sub> O emissions of campaign n (PE <sub>n</sub> ) and total nitric acid production (NAP <sub>n</sub> ).  |
| 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 <sub>2</sub> 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:<br><br>$EF_n = PE_n / NAP_n$ |
| QA/QC procedures to be applied:  | Not applicable.  |
| Any comment:   | None   |

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|--|--|
| <b>Data / Parameter:</b>   | <b>P.9 EF<sub>ma,n</sub></b>   |
| Data unit:   | tN <sub>2</sub> O/tHNO <sub>3</sub>  |
| 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 <sub>n</sub> .   |
| 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:                                 | 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:<br><br>$EF_{ma,n} = (EF_1 + EF_2 + \dots + EF_n) / n$<br><br>This process is repeated for each campaign such that a moving average, EF <sub>ma,n</sub> is established over time, becoming more representative and precise with each additional campaign. |
| QA/QC procedures to be applied:  | Not applicable.  |
| Any comment:   | None   |



|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>P.12 CL<sub>n</sub></b>   |
| Data unit:   | tHNO <sub>3</sub>  |
| 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<sub>n</sub>) has to be compared to the established average historic campaign length (CL<sub>normal</sub>); and</p> <p>If the length of each individual project campaign CL<sub>n</sub> is longer than or equal to the average historic campaign length CL<sub>normal</sub>, then all N<sub>2</sub>O 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<sub>n</sub> &lt; CL<sub>normal</sub>, recalculate EF<sub>BL</sub> by eliminating those N<sub>2</sub>O values that were obtained during the production of tonnes of nitric acid beyond the CL<sub>n</sub> (i.e. the last tonnes produced) from the calculation of EF<sub>n</sub>.</p> |
| QA/QC procedures to be applied:  | See comments for NAP.  |
| Any comment:   | None.  |

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|--|--|
| <b>Data / Parameter:</b>   | <b>P.13 EF<sub>p</sub></b>   |
| Data unit:   | tN <sub>2</sub> O/tHNO <sub>3</sub>  |
| 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 <sub>n</sub> and EF <sub>ma,n</sub> .  |
| 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>To calculate the total emission reductions achieved in a campaign, the higher of the two values EF<sub>ma,n</sub> and EF<sub>n</sub> shall be applied as the emission factor relevant for the particular campaign to be used to calculate emissions reductions (EF<sub>p</sub>). Thus:</p> <p>If EF<sub>ma,n</sub> &gt; EF<sub>n</sub> then EF<sub>p</sub> = EF<sub>ma,n</sub></p> <p>If EF<sub>ma,n</sub> &lt; EF<sub>n</sub> then EF<sub>p</sub> = EF<sub>n</sub></p> |
| QA/QC procedures to be applied:  | Not applicable.  |
| Any comment:   | None   |





|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>P.14 EF<sub>min</sub></b>   |
| Data unit:   | tN <sub>2</sub> O/tHNO <sub>3</sub>  |
| Description:   | EF <sub>min</sub> is equal to the lowest EF <sub>n</sub> observed during the first 10 campaigns of the project crediting period.   |
| Source of data to be used:   | Calculations of EF <sub>ma,n</sub> .   |
| 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 <sub>2</sub> 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 <sub>n</sub> observed during those campaigns will be adopted as a minimum (EF <sub>min</sub> ). If any of the later project campaigns results in a EF <sub>n</sub> that is lower than EF <sub>min</sub> , the calculation of the emission reductions for that particular campaign shall used EF <sub>min</sub> and not EF <sub>n</sub> . |
| QA/QC procedures to be applied:  | Not applicable.  |
| Any comment:   | None.  |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>OPh</b>   |
| 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 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 pressure in the ammonia oxidation reactor (OPh) has to be monitored and compared to the Normal range for oxidation temperature (OP<sub>normal</sub>). VSG and NCSG data obtained during times when OPh was above or below OP<sub>normal</sub> has to be eliminated from the calculation of EF<sub>BL</sub>.</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.                                 |

|  |  |
|--|--|
| <b>Data / Parameter:</b>   | <b>OTh</b>   |
| 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:                                 | 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 ( $OT_{normal}$ ).<br>VSG and NCSG data obtained during times when OTh was above or below $OT_{normal}$ has to be eliminated from the calculation of $EF_{BL}$ . |
| QA/QC procedures to be applied:  | Subject to ISO 9001/14001 procedures.  |
| Any comment:   | None.  |

|  |   |
|--|---|
| <b>Data / Parameter:</b>   | <b>AFR</b>  |
| Data unit:   | tNH <sub>3</sub> /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 $AFR_{max}$ . |
| 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.   |

|                          |   |
|--------------------------|---|
| <b>Data / Parameter:</b> | <b>AIFR</b>   |
| Data unit:               | % v/v   |
| Description:             | Ammonia to air ratio into the ammonia oxidation reactor                       |
| Source of data to be     | Calculation for each hour of plant operation based on measurements of AFR and |



|  |  |
|--|--|
| used:  | 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<sub>max</sub> 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<sub>max</sub> will be eliminated from the calculation of EF<sub>p</sub>.</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 Nm<sup>3</sup>/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 N<sub>2</sub>O 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*”<sup>11</sup> as a guidance for installing and operating the Automated Monitoring System (AMS) in the nitric acid plants for the monitoring of N<sub>2</sub>O emissions.

A complete Automated Monitoring System (AMS) to monitor the mass emissions of N<sub>2</sub>O at the stack of Haifa Chemicals’ N3 nitric acid plant was installed and has been operated since Q1, 2006. As an operator of the nitric acid plants for many years and of dedicated NO<sub>x</sub> 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 N<sub>2</sub>O 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.

<sup>11</sup> 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.



Please see 4 for a detailed description of the Automated Monitoring System (AMS) installed at Haifa Chemicals' N3 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' N3 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 N<sub>2</sub>O 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 plant<sup>12</sup>.

#### 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

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

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<sup>12</sup> The calibration report can be reviewed by the DOE during the site visit as part of the validation.



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 difficulty again with fully complying with EN14181 again is the lack of a regulatory N<sub>2</sub>O emissions level and measurement uncertainty limit. Also, Israel currently has no laboratory that would meet the accreditation requirements of EN14181.

#### Standard Reference Measurements (SRM)

A series of QAL2 specific measurements using the SRM method as per EN 14181 for guidance has been carried out at the plant in November 2006 by SGS to ensure the AMS’ suitability. The results of these SRM are available to the DOE as part of the validation process.

In future, Haifa Chemicals intends to employ a local technical auditing firm to conduct such SRM at least once per year.

#### **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 N<sub>2</sub>) 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 N<sub>2</sub>O in the balloon has been preformed in a laboratory that is designated from the national authority according to standard 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 N<sub>2</sub>O 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.

### QAL 3

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: OTh, OPh, AFR, AIFR, NAP, GS, GC, CL, incoming N<sub>2</sub>O regulation and changes in the NO<sub>x</sub> 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>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)</b> |
|---|

17. November 2006

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

N.serve Environmental Services GmbH

Mr. Albrecht von Ruffer (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:**

Expected: February 2007

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

Haifa Chemicals' N3 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:**

28 February 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 (N<sub>2</sub>O) 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 N<sub>2</sub>O 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:**

Confirmation by Ministry of Environment that no Environmental Impact Assessment is required has been obtained.

#### **SECTION E. Stakeholders' comments**

**E.1. Brief description<sup>13</sup> 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 N3 plant until the beginning of the Global Stakeholder Consultation process conducted by the DOE.

No comments were received.

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<sup>13</sup> More detailed information on the stakeholder consultation process than contained in the PDD is to be found in the Stakeholder Engagement Report.





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| 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 7<sup>th</sup> 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 ma-



terials. 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           | <a href="http://forums.nana.co.il/Forum/?ForumID=2074">http://forums.nana.co.il/Forum/?ForumID=2074</a>                               |
| Ynet                 | 02-Oct-06           | <a href="http://www.ynet.co.il/home/0,7340,L-870-7715,00.html">http://www.ynet.co.il/home/0,7340,L-870-7715,00.html</a>               |
| Tapuz                | 06-Oct-06           | <a href="http://www.tapuz.co.il/tapuzforum/main/forumpage.asp?id=174">http://www.tapuz.co.il/tapuzforum/main/forumpage.asp?id=174</a> |

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.   |
| Street/P.O.Box:  | P. O. Box 10809, Haifa Bay   |
| Building:        |  |
| City:            | Haifa  |
| State/Region:    | Haifa  |
| Postfix/ZIP:     | 26120  |
| Country:         | Israel   |
| Telephone:       | +972 4 846 9896  |
| FAX:             | +972 4 846 9940  |
| E-Mail:          |  |
| URL:             | <a href="http://www.haifachem.com">www.haifachem.com</a>           |
| Represented by:  |  |
| Title:           | Operations Division Manager  |
| Salutation:      | Mr.  |
| Last Name:       | Fetter   |
| Middle Name:     |  |
| First Name:      | Benny  |
| Department:      |  |
| Mobile:          |  |
| Direct FAX:      | +972 4 846 9940  |
| Direct tel:      | +972 4 846 9896  |
| Personal E-Mail: | <a href="mailto:fetter@haifachem.co.il">fetter@haifachem.co.il</a> |

|                 |  |
|-----------------|--|
| Organization:   | N.serve Environmental Services GmbH                        |
| Street/P.O.Box: | Grubesallee 12   |
| Building:       |  |
| City:           | Hamburg  |
| State/Region:   |  |
| Postfix/ZIP:    | 22143  |
| Country:        | Germany  |
| Telephone:      |  |
| FAX:            |  |
| E-Mail:         | <a href="mailto:contact@nserve.net">contact@nserve.net</a> |
| URL:            | <a href="http://www.nserve.net">www.nserve.net</a>         |
| Represented by: |  |
| Title:          | Managing Director  |
| Salutation:     | Mr.  |
| Last Name:      | von Ruffer   |
| Middle Name:    |  |
| First Name:     | Albrecht   |
| Department:     |  |
| Mobile:         | +49 177 65 15 964  |



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|                  |  |
|------------------|--|
| Direct FAX:      | +49 40 788 937 10  |
| Direct tel:      | +49 40 788 937 08  |
| Personal E-Mail: | <a href="mailto:ruffer@nserve.net">ruffer@nserve.net</a> |

|                  |                |
|------------------|----------------|
| Organization:    | [Escrow Agent] |
| Street/P.O.Box:  |                |
| Building:        |                |
| City:            |                |
| State/Region:    |                |
| Postfix/ZIP:     |                |
| Country:         |                |
| Telephone:       |                |
| FAX:             |                |
| E-Mail:          |                |
| URL:             |                |
| Represented by:  |                |
| Title:           |                |
| Salutation:      |                |
| Last Name:       |                |
| Middle Name:     |                |
| First Name:      |                |
| Department:      |                |
| Mobile:          |                |
| Direct FAX:      |                |
| Direct tel:      |                |
| Personal E-Mail: |                |



**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 campaign<sup>14</sup>:

| <b>N3 plant 354 catalyst baseline campaign</b> |                    |                 |                             |              |                  |                           |                                    |
|--|--------------------|-----------------|-----------------------------|--------------|------------------|---------------------------|------------------------------------|
| <b>The measurement period</b>                  |                    |                 | <b>The calc. constants:</b> |              |                  |                           |                                    |
| Campaign start:                                | 24/08/2006         |                 | V ideal gas                 |              |                  |                           |                                    |
| Campaign end:                                  | 08/11/2006         |                 | 22.415 m <sup>3</sup> /kmol |              |                  |                           |                                    |
|  |                    |                 | Mw N <sub>2</sub> O         |              |                  |                           |                                    |
|  |                    |                 | 44.013 kg/kmol              |              |                  |                           |                                    |
| <b>Parameter:</b>                              | <b>Temperature</b> | <b>Pressure</b> | <b>Ammonia feed</b>         | <b>Ratio</b> | <b>Acid Prod</b> | <b>Stok gas flow rate</b> | <b>N<sub>2</sub>O emission</b>     |
| <b>Units:</b>                                  | deg C              | barg            | kg/h                        | kmol/kmol    | kg/h             | Nm <sup>3</sup> /h        | mgN <sub>2</sub> O/Nm <sup>3</sup> |
| <b>Symbols:</b>                                | Oth                | Oph             | AFR                         | AIFR         | NAP              | VSG                       | NCSG                               |
| 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                            |

<sup>14</sup> 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 N<sub>2</sub>O are not yet defined in EN14181;
- Only very limited experience exists with monitoring systems for N<sub>2</sub>O emissions;
- No applicable regulatory N<sub>2</sub>O 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, N<sub>2</sub>O 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 N<sub>2</sub>O 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 N<sub>2</sub>O 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' N3 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 N3 nitric acid plant to continuously monitor N<sub>2</sub>O 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 certified<sup>15</sup> 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' N3 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.

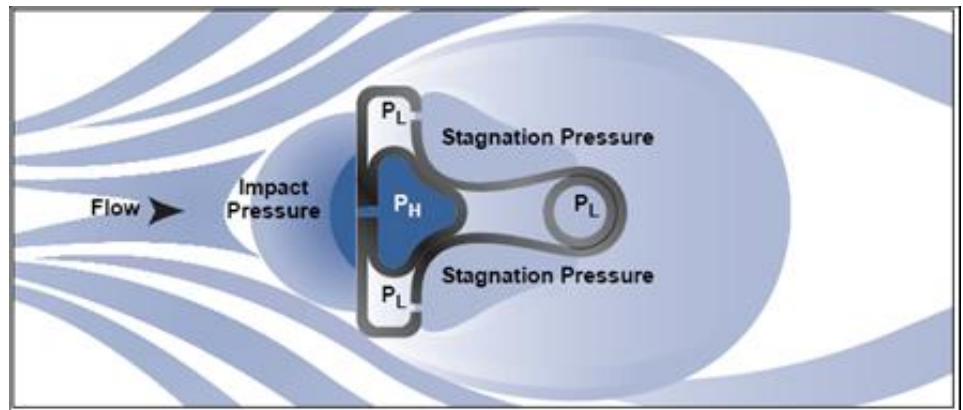
The Annubar generates a DP by partially blocking the flow. The velocity of the fluid is decreased and stalled as it reaches the upstream surface of the Annubar sensor, thus creating the Impact Pressure.

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<sup>15</sup> 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).