Ho Chi Minh City Environmental Improvement Project
Air Quality Monitoring Component

Mission 5, November 2004;
Status report (QR10-11),
Understanding air quality and data dissemination

Norwegian Institute for Air Research

Ho Chi Minh City
Environmental Improvement Project
Air Quality Monitoring Component
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Understanding air quality and data dissemination

Bjarne Sivertsen and The N. Thanh
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<th>Description</th>
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<tbody>
<tr>
<td>ADACS</td>
<td>Automatic Data Acquisition System</td>
</tr>
<tr>
<td>AQI</td>
<td>Air Quality Index</td>
</tr>
<tr>
<td>CO</td>
<td>Carbon monoxide</td>
</tr>
<tr>
<td>CEN</td>
<td>European Committee for Standardisation</td>
</tr>
<tr>
<td>CLRTAP</td>
<td>Convention on Long Range Transport of Air Pollutants</td>
</tr>
<tr>
<td>DANIDA</td>
<td>Danish International Development Assistance</td>
</tr>
<tr>
<td>DONRE</td>
<td>Department of Natural Resources and Environment</td>
</tr>
<tr>
<td>DOSTE</td>
<td>Department of Science, Technology and Environment.</td>
</tr>
<tr>
<td>EDC</td>
<td>Environmental Data Centre at DONRE</td>
</tr>
<tr>
<td>EPU</td>
<td>Environmental Protection Unit</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographical Information System</td>
</tr>
<tr>
<td>HCMC</td>
<td>Ho Chi Minh City</td>
</tr>
<tr>
<td>HEIA</td>
<td>HCMC Environmental Improvement Project Air Quality Monitoring component</td>
</tr>
<tr>
<td>HEIP</td>
<td>HCMC Environmental Improvement Project</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>NEA</td>
<td>National Environmental Agency</td>
</tr>
<tr>
<td>NILU</td>
<td>Norwegian Institute for Air Research</td>
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<tr>
<td>NO₂</td>
<td>Nitrogen dioxide</td>
</tr>
<tr>
<td>NORAD</td>
<td>Norwegian Agency for Development Cooperation</td>
</tr>
<tr>
<td>MPI</td>
<td>Ministry of Planning and Investment</td>
</tr>
<tr>
<td>PM₁₀</td>
<td>Particulate matter with diameter Less than 10 micrometer</td>
</tr>
<tr>
<td>PM₂.₅</td>
<td>Particulate matter with diameter Less than 2.5 micrometer</td>
</tr>
<tr>
<td>PIU</td>
<td>Project Implementing Unit (PIU)</td>
</tr>
<tr>
<td>QA</td>
<td>Quality Assurance</td>
</tr>
<tr>
<td>QC</td>
<td>Quality Control</td>
</tr>
<tr>
<td>SO₂</td>
<td>Sulphur dioxide</td>
</tr>
<tr>
<td>SOP</td>
<td>Standard Operating Procedures</td>
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<tr>
<td>SVN</td>
<td>Schmidt Vietnam Co. Ltd</td>
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1 Task 1. The AQ system for HCMC

1.1 Introduction

The Norwegian Institute for Air Research, NILU, has been appointed to undertake the NORAD funded part of the air quality monitoring component of the Ho Chi Minh City Environmental Improvement Project (HEIP). The NORAD supported part of the project (phase 2) is based on a DANIDA funded (phase 1) project, and it is a component of the ADB funded Ho Chi Minh City Environmental Improvement Project. The UNDP through the “Environmental Management Ho Chi Minh City, Air Quality Monitoring Project” was responsible for phase 1 of the project.

The Executing Agency for the Ho Chi Minh City Environmental Improvement Project Air Quality Monitoring component (HEIA) was the Department of Science, Technology and Environment (DOSTE). After re-organisation of DOSTE the Department of Natural Resources and Environment (DONRE) has taken over the responsibility. A Project Implementing Unit (PIU) has been established under the HEIP programme, and this will co-ordinate and manage all activities required for the daily implementation and management of the components, while reporting and maintaining continuous contact with the MPI. The PIU will be responsible for the administration and supervision of the implementation of the Air Quality Monitoring component.

The NORAD project undertaken by NILU has now been established and is being operated by trained DONRE experts. During the last year DONRE has received training and is operating both the measurements as well as the air quality management system AirQUIS. Mission 5 to HCMC was undertaken from 4 November to 4 December 2004, and included:

- Sign agreement for the establishment of a Reference Laboratory and continued institutional building
- Upgrading the AirQUIS system and continue training local experts
- Data quality controls of air quality and meteorological data
- Continue collecting emission data for modelling purposes
- Perform some model test runs using new input data
- Discuss the establishment of a Reference Laboratory including time schedules for instrument purchase and testing
- Prepare paper on air quality in HCMC
• Prepare input to a state of the air quality report for HCMC based on the on-line data collection
• Status and final reporting of the HEIA project.

The daily schedule for Mission 5 is presented in Appendix A1

A brief status report of the HEIA project was prepared in connection with the Review team from the Norwegian Pollution Control Authority (SFT) who visited HCMC 11 to 16 November 2004. The Review Team had planned meetings with HEPA and with the NILU project manager in Ho Chi Minh City in November 2004.

Installations, training, data follow-up and reporting have been elements already in place at DONRE/HEPA. A follow-up programme including the establishment of a Reference laboratory as well as further training and institution building has been developed and presented to NORAD.

The following tasks and topics related to the project were briefly described in the memo, prepared for the review team:
• Instrument installations and audits
• System integration
• Database and planning tool (AirQUIS installation)
• Data collection and management
• Data assessment, interpretations and air quality status
• Input data for modelling (emission data collection)
• Capacity building
• Reference laboratory and further training

The project has been undertaken according to the original plans and contracts, and has also been kept within the estimated budget available. For further details see Appendix A2.
2 Task 2. Design and update

2.1 Monitoring sites operated

A final updated list of monitoring stations were prepared in connection with discussions about a possible health related project to be conducted by the Asian Development bank. The table below summarizes the stations, station characteristics and positions.

Table 1: Air pollution measurement sites in HCMC, site characteristics and positions.

<table>
<thead>
<tr>
<th>ID</th>
<th>Code</th>
<th>Code</th>
<th>Name</th>
<th>Character</th>
<th>PM10</th>
<th>NO2</th>
<th>SO2</th>
<th>O3</th>
<th>CO</th>
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<tr>
<td>1</td>
<td>DO</td>
<td></td>
<td>DOSTE</td>
<td>Traffic</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>2</td>
<td>HB</td>
<td></td>
<td>Hong Bang</td>
<td>Traffic</td>
<td>X</td>
<td>X</td>
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<td>3</td>
<td>TD</td>
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<td>Thu Duc</td>
<td>Res/Ind</td>
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<tr>
<td>4</td>
<td>TS</td>
<td></td>
<td>Tan Son Hoa</td>
<td>Urb Bkg</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>5</td>
<td>TN</td>
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<td>Thong Nhat</td>
<td>Traffic</td>
<td>X</td>
<td>X</td>
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<td>6</td>
<td>BC</td>
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<td>Binh Chanh</td>
<td>Traffic</td>
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<td>7</td>
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<td>X</td>
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<tr>
<td>8</td>
<td>D2</td>
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<td>District 2</td>
<td>Res/Ind</td>
<td>X</td>
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<tr>
<td>9</td>
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<td>X</td>
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A map of HCMC with the locations of the nine sites is presented in Figure 1. The five stations established by NILU as part of the NORAD financed programme seem to be working well, while several of the instruments installed by the Danida project was presently out of operations. Some of the instruments may be repaired as soon as spare parts are being made available.

However, the PM10 monitors delivered by the Danida project all seem to be out of function, and cannot be repaired. HEPA has expressed need for additional PM10 monitors. This is not possible within the NORAD budgets.

Also the meteorological equipment is still not working well. It is of utmost importance that these instruments will work in the future and NILU is looking into the possibility of replacing some of the sensors in the near future.
Figure 1: The location of the nine automatic air quality monitoring sites in HCMC.
3 Task 3. Procure and install

3.1 Specifications
All basic instruments as well as computer equipment needed to operate the air quality monitoring system including the GIS based air quality database and planning system has been delivered and was specified in Appendix C of Mission report 3.

NILU has been co-operating with HEPA during the last few months to specify and support in defining the necessary spare parts for operating the system. See also Ch. 8.4.

In August we specified that the consumables covered by the project is about 70,000 NOK. The extra 5 OPSIS internal modems, which had been requested from HEPA cost 3,570 NOK each.

NILU prepared and sent the consumables and the modems as one package with the value of app. 90,000 NOK for the packing list and Proforma Invoice. HEPA received a separate invoice for the modems.
NILU also prepared a spare part inquiry to the API Supplier regarding price and delivery time. The costs for these spare parts were covered by HEPA.

3.2 AirQUS installations and modifications
Installations of AirQUS at HEPA were undertaken on 3 – 5 November 2003. Improvements and modifications were implemented during the Mission 5 in November 2004.
A list of deliveries connected to the AirQUS work during Mission 5 is presented in Appendix C
4 Task 4. Assure system integration

4.1 Evaluate OPSIS system and improve routines

NILU extended the existing data retrieval system from 4 to 5 new measurement stations supported by NORAD. All 9 stations are now operating well in the total system. ENVIMAN Comvisioner supported by the DANIDA project is running well at together with the NORAD supported AirQUIS database and management system at HEPA.

4.2 Integrating the existing data retrieval system into AirQUIS

Data are automatically entered into the AirQUIS database and data quality controls have been improved during the Mission 5.

The automatic import module and the automatic AQI routine, which was implemented from November 2003 is working well. The figure below shows an example of the AQI values produced by AirQUIS every day during 2003.

Figure 2: Daily AQI values in HCMC for traffic sites and urban background sites, 2003.
Figure 2 shows the daily AQI for traffic and urban background environments in HCMC for the year 2003. The AQI values generated based on data from traffic stations are generally about 60% higher than those generated from urban background stations. The air quality is most often characterised as moderate to poor.
5 Task 5. Quality Assurance (QA/QC)

5.1 Design QA/QC and documentation materials

Data collection is being followed up on a daily and weekly basis using the QA/QC procedures prepared by NILU. The field operations require that trained monitoring experts are visiting the stations every week. Other experts have been trained for using the data retrieval systems and the databases. QA/QC at all levels is an important issue that should be kept alive through regular auditing of the system, also in the future.

Some of the field operators or special assigned experts will be responsible for maintenance, repair and calibrations. The instruments in question contain:
- Automatic gas monitors
- Automatic ambient suspended particle monitors
- Automatic Weather stations

The establishment of the Reference and maintenance/repair laboratory will ensure that the programme will sustain good quality.

5.2 Quality control at data retrieval

The daily control of the data is manually undertaken as soon as data have been retrieved. Data checks and data quality is being registered in a daily data validation manual.

The quality of data in the final database was checked and verified during Mission 5. It was found that the follow-up of final data quality including identification and flagging of errors had not been followed up adequately. New routines for printing and additional controls of data were developed and implemented.

A short description of the new quality routines is presented in Appendix E1. These will be checked at the next mission during the establishment of the Reference Laboratory.
5.3 QA/QC training

Additional training concerning quality assurance, calibrations, repair and maintenance will be performed as part of the establishment of the Reference Laboratory at HEPA.

Through the statistical assessment and evaluation of data for the first two years of measurements it has been seen that quality routines will have to be updated. All routine operations and the use of standard operational procedures (SOP) and monitoring operations seem to have been followed up adequately. This will again be checked during the next phase of the project.

5.4 Station Audit descriptions

Simple station audits were performed during Mission 4. More detailed audits will be undertaken at the beginning of the Reference laboratory phase of the project. Visits to the stations during Mission 5 have proven that all station- and instrument logbooks are adequately followed up. The stations are kept clean and in good order.

Some instruments were out of order due to lack of spare parts. These are now being ordered and instruments will be repaired and set in operation again.

5.5 Data corrections for wind and temperature

The meteorological sensors, however, are still not functioning according to expectations. Much work was undertaken during Mission 5 to correct and produce "new" and improved data needed for the operations of the database and some of the statistics to be performed on the air quality/meteorological data.

Correction factors introduced for obtaining better wind direction data are shown in Appendix E2. Similar procedures were used to create a lower temperature parameter based on the measured temperatures at 30 m level on the tower (upper temperature), See Appendix E3.

We concluded again that some of the sensors might have to be changed in the future.
6 Task 6. Install and improve AirQUIS performance

6.1 Prepare AirQUIS platform and GIS

The AirQUIS system was installed at during Mission 3 in November 2003. The PC server and the client PC was then connected to the existing network in the DONRE data centre.

The GIS maps and different layers and shape files have also been installed and tested. The following topics are completed:

- Administrative regions for HCMC are completed.
- Measurement station sites are completed.
- Main roads and road links
- Rivers and water ways

The stack coordinates available have to be checked and corrected again. New roads, which are being counted, now need to be incorporated.

HCMC administrative region for 24 districts, 9 measurement stations, 45 stacks, 63 roads and a grid of 43 EW and 35 NS with 1 km resolution have been entered and verified.

The status of the AirQUIS GIS platform can be seen in Figure 3.
6.2 Further development and testing

NILU is continuing to improve AirQUIS regarding stability, performance and features, and new releases of AirQUIS have been made available for HEPA during the whole HEIA project period. The GIS system had some minor bugs that were corrected during Mission 5. The current version of AirQUIS version #421 at HEPA enables the users to modify and save the line sources after the shape has been imported as AirQUIS Theme. The previous GIS problem is now solved.

Training was given concerning the creation of a local Oracle database with AirQUIS (see Appendix F).
7 Task 7. Air Quality Modelling

7.1 Prepare input data

HEPA has been working on the preparation of input data to the models. Traffic counting has not proceeded as fast as anticipated. However, during mission 5 a new campaign was launched to count all major roads surrounding the city centre.

Model estimates are based on emission data from line-, point-, and area sources. The possible relations between different source types and different result data sets are shown in Figure 4.

![Graphical presentation of emission sources and emission results.](image)

The result emissions can be stored as field data sets for area sources, line and field data sets for road links and point data sets for point sources. In addition, the model may have to perform spatial transformations, and scale the resulting values in order to convert to the desired units for the resulting data set.

7.2 Emission inventories

The emission inventory of point sources started at HEPA after Mission 3. The emission inventory work has been based on templates from AirQUIS and the methodology given by NILU as presented in previous Mission reports.
7.2.1 Point sources

The principle of modelling emissions from point and area sources is very simple. For consumption data the emission will be calculated as:

\[
Q = \text{Consumption} \times \text{"Consumption Emission Factor"}
\]

where

\[
Q = \text{Emission rates}
\]

If emission data for the sources is available as initial input, there is of course no such calculation.

A total of 35 industries with coordinates have been collected by HEPA. 45 stacks have been identified with 30 processes together with consumption data given as ton per year. More stacks are under verification. The validity period for most of these stacks is 2003. The fuels included are: fuel oil, coal and diesel heavy oil.

The positions of the stacks in the AirQUIS GIS system are being verified and corrected.

7.2.2 Population distribution, area sources

To improve the quality of area source estimates population distributions for each ward within every District of HCMC was obtained during Mission 5.

For District 1 in the central part of HCMC the data looks as shown in the Table below. This information will be used during the next phase to estimate the remaining area source part of the traffic emissions.

<table>
<thead>
<tr>
<th>Area, Population of regions HCMC</th>
<th>No</th>
<th>Name of District and Ward</th>
<th>Area(Km2)</th>
<th>Population (people)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCMC area</td>
<td></td>
<td></td>
<td>2094.34</td>
<td>5 250 257</td>
</tr>
<tr>
<td>District 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Ward B?n Nghé</td>
<td>1</td>
<td>2.49</td>
<td>21 429</td>
<td></td>
</tr>
<tr>
<td>2 Ward B?n Thành</td>
<td>2</td>
<td>0.93</td>
<td>21 257</td>
<td></td>
</tr>
<tr>
<td>3 Ward Cô Giang</td>
<td>3</td>
<td>0.36</td>
<td>23 915</td>
<td></td>
</tr>
<tr>
<td>4 Ward C?u Kho</td>
<td>4</td>
<td>0.34</td>
<td>20 584</td>
<td></td>
</tr>
<tr>
<td>5 Ward C?u Ông Lánh</td>
<td>5</td>
<td>0.23</td>
<td>17 959</td>
<td></td>
</tr>
<tr>
<td>6 Ward Da Kao</td>
<td>6</td>
<td>1</td>
<td>23 528</td>
<td></td>
</tr>
<tr>
<td>7 Ward Nguy?n Thái Bình</td>
<td>7</td>
<td>0.49</td>
<td>19 441</td>
<td></td>
</tr>
<tr>
<td>8 Ward Nguy?n C? Trinh</td>
<td>8</td>
<td>0.76</td>
<td>25 914</td>
<td></td>
</tr>
<tr>
<td>9 Ward Ph?m Ng? L?o</td>
<td>9</td>
<td>0.49</td>
<td>22 636</td>
<td></td>
</tr>
<tr>
<td>10 Ward Tân D?nh</td>
<td>10</td>
<td>0.63</td>
<td>30 072</td>
<td></td>
</tr>
</tbody>
</table>

The data may also be used to distribute the human generated emissions of particles as area sources. However, more basic information of fuel types and activities has to be obtained first.
7.2.3 Line sources and traffic emission data

Templates and methodologies for traffic counting and line source emission estimates were given to HEPA during Mission 3 and 4. (Sivertsen et.al. 2003, NILU OR 84/2003). During Mission 4 a total of 77 road nodes with coordinates and 63 road links had been identified.

Figure 5 below indicated the roads counted as green lines and also the roads selected for counting during and after Mission 5 (blue lines).

A time schedule for the counting started during Mission 5 is presented in Appendix G1. Students have been engaged together with HEPA experts to perform the counting. Both total average daily traffic as well as diurnal variations (counting every hour in selected streets) are included in the work.

The emission estimates based on Vehicle Classes are Average Model year, Average driving distance, fuel consumption, basic factor, aging factor and speed dependency factor is mainly based on European methodology, but emission factors are based on experience in Asia.
7.3 Dispersion modelling

Mr. Dam was trained during a study visit to NILU to use the dispersion models available in AirQUIS. The first model tests have been undertaken based on input data from HCMC. During the summer 2004 more model runs were presented.

The main results of some of these model runs performed along the main road running towards north-east (Hanoi) in the TuDuc area was that the emissions from the road is totally domination the concentration distributions in this area.

All compounds simulated in the EPISODE model are treated as non-reactive species with the exception of NO, NO₂ and ozone. For the dispersion and transport calculations these components are also treated as non-reactive but at the end of every hour the photo stationery state assumption is applied and the concentration of these components is calculated accordingly.

The photo stationery state is the instantaneous equilibrium between the following three reactions:

\[ \text{NO}_2 + \text{hv} \rightarrow \text{NO} + \text{O} \]
\[ \text{O} + \text{O}_2 + \text{M} \rightarrow \text{O}_3 + \text{M} \]
\[ \text{O}_3 + \text{NO} \rightarrow \text{NO}_2 + \text{O}_2 \]

The steady-state assumption implies that NO\(_X\) (the sum of nitrogen oxides) and O\(_X\) (oxidants) are conserved. By these assumptions the three components NO, NO\(_2\) and ozone can be found by the solution of a second-degree equation in Ozone.

The AirQUIS models also require good quality meteorological input data. We are still not satisfied with the situation regarding this issue, but we are working together with HEPA to solve the problem.
8 Task 8. Field Operations

8.1 Operational phase
The air quality monitoring system in HCMC has now been entered into an operational phase. Data is retrieved to the AirQUIS database automatically, and the database seems to be complete.

Field operations undertaken by the trained monitoring experts using the QA/QC system at all levels seem to work adequately.

The analyses of the data in the database has revealed that there are still missing data from time to time. In some cases there has not been sufficient follow-up of the final data. However, missing data are mainly due to power failures of various kinds. Some of the monitors have been out of order for shorter or longer periods due to lack of spare parts. These matters have all been discussed and it is believed that the operations might be still improved.

8.2 Maintenance and service
Some instruments (from Danida) have now been operated for more than 5 years. The lifetime of some of these monitors are between 5 and 10 years. To keep up good quality data they need to be checked and maintained properly. NILU normally recommends a yearly overhaul of the instruments. This will in the future be one of the tasks of the reference and maintenance laboratory.

The PM$_{10}$ samplers provided by the Danida project are all out of operations, and it is not believed that these instruments can be utilised any more.

8.3 Consumables and spare parts
During the HEIA project NILU has supported consumables and spare parts. This service has terminated. However, NILU has still given advice and support to HEPA. An example of the spare parts needed to operate some of the instruments delivered by the Danida project is presented in Appendix H1.
8.4 Dynamic calibrations

After signing the contract and agreement between DONRE and NILU about the establishment of a Reference Laboratory and additional training it is now clear that the Reference laboratory will be established at DONRE/HEPA.

The required dynamic calibrations will then be performed after instructions and training provided by NILU.

The locations for the Reference Laboratory at HEPA will be identified as soon as the new building and the moving of HEPA has been undertaken in the beginning of 2005, as well as undertake the necessary training for maintenance and calibrations. Support

The programme will identify the necessary equipment for the Reference Laboratory, perform the procurement and test and verify the equipment before shipping it to HCMC. A training programme including on-the-job training will be performed and instrument and station audits will be added as part of the Reference laboratory tasks.
9 Task 9. Data interpretations

9.1 Understanding AQ
Much of the time during Mission 5 was spent on the evaluation and assessment of the data. The work was undertaken as part of the development of a status report concerning the general air quality situation in HCM City.

The results and development was discussed with the HEPA staff and the report was presented in a seminar as part of the training during Mission 5.

9.2 Meteorological data
The errors that are still present in the meteorological data were modified and “corrected” as presented in Appendices E1 and E2.

This time only upper temperature data and wind speed data at the DOSTE station seem to be of adequate quality. We will have to do something with this problem. However, presently there are no funds available from outside sources to purchase new equipment.

9.3 Statistical evaluation
The air quality data available in the AirQUIS database was used to present typical annual average concentrations as well as discuss the possibilities of exceeding national and international limit values for air quality.

It was concluded from the analyses that the main air pollution problem in HCM City consists of suspended particles and oxidants measured by ozone.

Further the conclusions from the measurements after 3 years of operations were:
- The main problem is suspended particles, and PM$_{10}$ concentrations are frequently exceeding limit values
- High ozone concentrations have been observed on dry hot days, also exceeding international standards and limit values
• NO₂ concentrations seldom exceed limit values, but very high concentrations have been observed in and close to roads and streets
• Generally high concentrations of suspended particles and oxidised pollutants occur along streets and roads
• The Air Quality Index values as defined in HCMC seldom reach bad or hazardous level, but this is also dependent upon the definition of limit values
• 8-hour average CO concentrations exceed limit values during rush hours in several streets

The annual average PM₁₀ concentrations are presented in Figure 6 below.

Figure 6: Annual average PM₁₀ concentrations measured at 7 sites in HCM City from 2001 to 2004.
As can be seen from the figure all sites show that the limit values as given both by the US EPA and the European Directives have been exceeded. Vietnam have not specified limit values for PM$_{10}$.

More details concerning the air quality in HCM City is presented in the report on the status of air quality in HCM City (Sivertsen et.al., 2004a). These results were also presented at the “Better Air Quality, BAQ Conference in Agra India in December 2004. (Sivertsen et.al. 2004b).

9.4 Reporting Air Quality Index (AQI)

The Air Quality Index (AQI) procedures developed in 2003 have been generated automatically every day for more than a year. The values for 2003 can be seen in Figure 2 Chapter 4.2.

The AQI values generated based on the traffic stations are higher and are more often characterised as “bad air quality” than the data taken from the urban background stations. Poor air quality has AQI values above 100. Figure 7 indicates that the traffic stations are much more often in this range. Also the traffic AQI was on the average about 40 % higher than the urban background.

![Figure 7: AQI at traffic stations versus AQI values at the urban background stations.](image)

This indicates that the man air pollution problem in HCH City is related to traffic.
9.5 Internet presentations

NILU has demonstrated and introduced for HEPA the concept of how to present Air Quality Information and establish a Air Quality Web Portal.

Establishing of a web site for HEPA is not a part of this project. However, HEPA decided to establish a HEPA web site with HEPA resources and assistance from NILU.

NILU as an Air Quality Service Provider will provide HEPA the solution as a service hosted from NILU Norway. The web site is under testing by HEPA. Before releasing of the HEPA web site, NILU will need an approval from DONRE including a signed Leasing Agreement for the HEPA web site service.

See: www.nilu.no and www.luftkvalitet.info for more information about NILU as Air Quality Service Provider.

The development of a web site for HEPA was discussed during Mission 4, and the work was undertaken during Mission 5. The examples below demonstrate the features of the HEPA web site.

HEPA Web Site Portal

This is the start page for HEPA Web Portal:
HEPA – AirOnline

The AirOnline provides the following features:

- Multilanguage – Vietnamese and English
- Visualization of the daily HCMC Air Quality Index (AQI) for Urban and Traffic based on the HTML input file produced by AirQUIS. HEPA will FTP the daily AQI to NILU
- Visualisation of the monitoring network on a scanned electronic map of HCMC
- Description of the measurements stations
- Features for providing links
- Features for uploading documents and reports as links
- Feature for administration of the Air Quality Information Dissemination Portal - AirOnline
10 Task 10. Air Quality Assessment

10.1 Use of AirQUIS

The AirQUIS system is presently being used for developing statistics as input to the air quality assessment. It is further being prepared to improve modelling capacity so that it can also be used for air quality management and planning. The preparations of adequate input data are still ongoing and before a rather complete emission inventory has been prepared the planning system used for the whole city will not work properly.

However, in many cases it is already possible to perform simple impact assessment studies using the models for single sources or groups of sources and line sources. One such modelling exercise was performed for sources located in the Thu Duc area. The results of these model estimates showed that the impact of emissions from the traffic along the main road to Hanoi was larger than the impact from industrial emissions included the power plants.

The collection of good quality meteorological data as well as input data to the models is still going on. When this work is finalised it will improve the ability to use AirQUIS for air quality assessment and planning.

10.2 Improved model estimates for exposure evaluations

The models available in AirQUIS for concentration estimates as well as for the modelling of exposure to the population is continuously being revised and improved at NILU. The versions prepared for the HEIA project in HCMC have been evaluated and is updated to represent the best available models for estimates of concentrations based on emission- and meteorological data as input. The modelling system available in AirQUIS has only briefly been tested and used in HCM City. Work was also undertaken to improve the system during Mission 5.

As part of future requirements for model estimation of concentration distributions as well as exposure estimates every hour in selected receptor points the models may have to be modified again to include a statistical optimisation of the estimates.
A Now-cast model has recently been built as an integral part of the AirQUIS system and can be run directly from menus offered within the system. It combines observed air quality data with model simulations to produce assimilated fields for the components such as NO₂, PM₁₀, SO₂ and Ozone. It will also calculate the Air Quality Index (AQI). The various elements of the Now-cast model are shown in the flow chart given in the Figure 8 below.

Figure 8: Data and logical flow diagram showing the AirQUIS data flow structure used for the automatic Now-cast model.

The elements of the Now-cast model consist of:

- Input data from the AirQUIS database made up of
  - Archived traffic data
  - Archived stack emission data
  - Updated meteorological data
  - Updated air quality observational data

- These data are sent to the EPISODE dispersion model which calculates hourly concentration fields using
  - Emission models for traffic and point sources
  - An Eulerian grid model
  - The INPUFF Gaussian puff model
  - The HIWAY line source model for traffic

- Simulated concentration fields are then sent to the assimilation module, which adjusts model results using updated observational data interpolated onto the model domain. This module uses:
  - Local positional adjustment
  - Scaling factor calculation
  - Observational field interpolation
  - Weighting factor field calculation
  - Assimilation of model and observed fields
• The Air Quality Index calculation is then made using
  - Assimilated field calculations for the relevant air pollutants
    given in the AQI procedures.

10.3 Abatement and planning

As part of the additional funds made available from NORAD the training of HEPA experts will continue. The AirQUIS modelling and planning procedures will be used as they already have been installed at HEPA. Emission reduction scenarios may be based on the Master Plan or Action Plans available for HCMC. The preparation of emission scenarios based on measures to improve the air quality in HCMC will be undertaken by local experts.

In the case of an additional ADB financed project on air quality and health among the poor people of HCM City, it will be necessary to modify and improve the modelling system according to the procedures presented above based on the newly developed Now-cast procedures.
11 Task 11. Capacity building

At the end of the NORAD financed HEIA project we have signed the contract for a continuation including the development of a reference laboratory as well as additional training in the air quality assessment and planning.

The additional funds made available from NORAD will help to improve the operational capacity and the Quality Assurance part of the air quality monitoring programme and also improve the capacity concerning air quality management and abatement strategy planning.

11.1 Instruments, monitors and QA/QC procedures

Training concerning the operations of instruments as well as collection and quality controls has been given during the HEIA project as hand-on training by the instrument provider API directly to one of the HEPA experts.

Additional training will also be a key issue in the development of the Reference Laboratory. This training will also include maintenance and repair in addition to the procedures for dynamical calibrations of the monitors.

Additional training in the use of the AirQUIS system for daily quality check of data was undertaken during Mission 5. New procedures were also established as seen in Appendix E1.

11.2 AirQUIS training

The main part of the AirQUIS training programme was based on seminars and workshops prepared at NILU for selected experts from HEPA/DONRE. (Laupsa and Johnsrud, 2003). Additional training has been given by mail and during Mission 5.

Experts have been trained to undertake the collection of emission data for the emission inventory in AirQUIS. Also the dispersion models should after Mission 5 be well known to at least one expert at HEPA.
HEPA technical personnel have been trained in how to install a local AirQUIS database for testing purpose during mission 5.

11.3 Use of models
Mr V T Dam was trained in the application of models at NILU in February 2004. A first simple models estimation was undertaken during this training. Later Mr Dam has also imported emission data as well as meteorological data to the models to perform simple estimates of concentration distributions in the Thu Duc area. The input data are still not completed enough to perform a complete model estimate of the concentration distribution over HCM City. However, this work is underway and we foresee that during the next phase of the NORAD/NILU support we will have to add to the training in the application of the models.

11.4 Statistics and reporting
During Mission 5 a considerable part of the time was used to prepare a status report on air quality in HCM city. (Sivertsen et.al. 2004). The report was presented in a seminar at HEPA and at the BAQ conference in Agra India.

During the development of this report a number of statistical programmes available in AirQUIS were used. The outcome as well as input data and limitations were discussed with HEPA experts as part of the training. We still believe that further training may be needed in the preparation of air quality statistics and data interpretations.

11.5 Abatement strategies
Procedures for air quality impact assessments as well as preparation of abatement options and scenarios started during the HEIA project. However, it will be further needs for adding to this part of the institutional building programme.

Cost-benefit analyses can be used to evaluate the best possible options to reduce the air pollution load seen from an economic point of view. The results of such analyses again should lead to the development of Action plans.

Within the limited budget NILU can together with the client define the strategic objectives of an Air Quality Management and planning System (AQMS), and support the selection of tools, modules and components to be used in a specific situation and for a defined area of interest. Training in the application of AirQUIS as a basis for performing abatement strategy planning will be prepared, but the work itself will have to be undertaken locally. NILU may, if wanted, participate in the process as part of the on-the-job training programme.
11.6 Further institutional building

HEPA and DONRE have been re-organised. The present office buildings and the computer centre at HEPA will not be their permanent location. We were told that they would move again into a new building within a few months. A group of 9 experts is presently working with environmental data and issues linked to pollution. These experts need to have updated knowledge of methods and data to represent the key personnel in the future Division of Environmental Quality, Monitoring and Assessment (EQMA) at HEPA.

The air quality monitoring programme as well as the air quality management system established and developed at HEPA in HCM City should be used in the further development of air pollution administration in Vietnam. It will be important to build on the expertise established through the NORAD supported HEIA project. The HEPA/EQMA Centre should market its capacity as the main air pollution experts in Vietnam. The establishment of the new centre may thus need further training as part of the institutional building.

As part of the continued NORAD funded project NILU will do its best to update and to assure that the EQMA centre have the best tools available and that adequate training is being given to the staff.

The central authorities in Hanoi represented by the Vietnam Environmental Protection Agency (VEPA) have already contacted HEPA/NILU to learn about the system in HCM City and to discuss possibilities for future co-operation. See Chapter 12.
12 Administrative meetings

12.1 Administrative meetings
Several meetings were organised at DONRE and HEPA during Mission 5. The results of these meetings may be found in the appendices as Minutes from the meetings or in various memos. Project meeting have also been held at NILU.

12.1.1 Project meetings
Project meetings have been held at NILU to follow-up the project. Minutes of these meetings have been sent to HEPA/DONRE. The last meeting held after Mission 5 and as a preparation for the extended Reference Laboratory project can be found in Appendix L1.

12.1.2 Meeting at DONRE head office
In preparatory meetings for the last Mission (5) of the HEIA project and during the planning of the contract signing at DONRE HEPA/NILU was asked to present the down payment schedule, the status and the available reports linked to the invoices. (See Appendix L2)

A summary of the reports that have been developed during the project was presented. Copies of the reports as well as some background material presented to the DONRE/HEPA experts were also been made available on a CD presented to DONRE.

12.1.3 Meeting with Swisscontact
Swisscontact had asked for a meeting with HEPA/NILU to receive information of the air quality monitoring and management programme developed and operated in HCM

The Swiss-Vietnamese Clean Air Program SVCAP is currently conducting a situation analysis on the availability and quality of air pollution data in Hanoi. Based on the situation analysis, they plan to come up with a concept for the future air quality monitoring system in Hanoi, included
Lukas Heer is the Project Manager of SVCAP, and was heading the delegation to HPA: For further information see Appendix L3.

### 12.1.4 Meeting with VEPA/MONRE, Hanoi

Dr. Hoang Duong Tung, Director for the Centre for Environmental Monitoring, Data and Information (CEMDI) at VEPA/MONRE and Mr. Thai Minh Son from MONRE in Hanoi visited HEPA HCMC on 23 November 2004 to discuss the NORAD financed HEIA project and possible future co-operation between HEPA and VEPA. They were informed about the work undertaken as part of the NORAD project and were impressed and interested in a follow-up programme (See Appendix L4).

After the meeting it was clear that VEPA and HEPA have the intention for a close cooperation regarding utilising the competence and experience gained by HEPA through the NORAD funded project.

Further objectives and needs for the air quality monitoring and management in Hanoi and for Vietnam were discussed during the BAQ seminar in Agra India on 7 December 2004. NILU has also been asked to participate in a meeting called by the World Bank in Hanoi on 26 January 2005.

### 12.1.5 Preparations for the new Ref-lab project

The contract for the new project with a budget of 1.7 mill NOK was signed between DONRE and NILU on the establishments of a Reference Laboratory including maintenance and repair capacity building, plus additional training for the application of the AirQUIS system for air quality planning in HCMC.

The main objectives of the new project are to improve the institutional capacity at HEPA/DONRE.

The main tasks to be undertaken in the project are:

1. Specify and approve the physical location and features of the laboratory
2. Design the reference laboratory
3. Procure equipment
4. Test and verify equipment
5. Shipping of equipment
6. Install, verify and test the equipment in the laboratory
7. Develop training programme for maintenance, repair and calibration
8. Develop QA/QC programme related to Reference laboratory activities
9. Perform audits and train the ref-lab personnel
10. Update the database and collect input data
11. Meteorological data, training and improve instruments
12. Perform training in air quality assessment, seminar
13. Improve modelling capacity
14. Undertake impact evaluation
15. Prepare HEPA for undertaking abatement planning
16. Improve data dissemination and information

The location and layout of the laboratory has been discussed but the final design will depend on the new building and facilities made available to HEPA during the first months of 2005.

Also the procurement procedures and the purchasing of necessary instruments were discussed. Details have been presented in Appendix L1.

12.1.6 Future tasks and obligations

At the end of the Mission a meeting was held to summarise the performances so far. This Mission 5 is the last Mission of the original HEIA project. All the tasks given in the project proposal have been undertaken.

The air quality monitoring and management system is up and operating well in HCM City. The quality assurance, data collection and the databases are working properly. The remaining installation of an adequate reference laboratory for calibrations, maintenance and repair was identified early in the project, and ha now been financed by NORAD to be installed during the next year.

The staffs have been trained to collect input data for the modelling and assessment work. These tasks will be further followed-up by NILU during the next phase of the project.

Some immediate action to be taken in the near future were specified and discussed. A list of tasks and obligations is presented in Appendix L 5. A major effort will be to continue collecting input data for the modelling and assessment study.

NILU is pleased to be able to further follow up the good work that has been undertaken by the trained experts at HEPA/DONRE. The new Reference laboratory project will assure that the future co-operation will further improve the quality of the measurements as well as enable better model estimates to be presented.
13 References


Appendix A

Task 1. The air quality System for HCMC
### Appendix A1: Daily schedules

#### Mission 5, November 2004

<table>
<thead>
<tr>
<th>Day</th>
<th>Hr.</th>
<th>Assignment</th>
<th>NILU</th>
<th>HEPA/ DONRE</th>
<th>Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday 8 Nov</td>
<td>0830</td>
<td>Meetings ADB health study Identify data quality in AirQUIS</td>
<td>BS</td>
<td>VTD</td>
<td>ok</td>
</tr>
<tr>
<td>Tuesday 9 Nov</td>
<td>0830</td>
<td>Work with the AirQUIS database, install “new” data</td>
<td>BS</td>
<td>VTD</td>
<td></td>
</tr>
<tr>
<td>Wednesday 10 Nov</td>
<td>0830</td>
<td>Memo status + database work</td>
<td>BS</td>
<td>VTD, LVK</td>
<td>ok</td>
</tr>
<tr>
<td>Thursday 11 Nov</td>
<td>0900-1130</td>
<td>1330 Meeting DONRE with SFT assessment team</td>
<td>BS</td>
<td>LVK, VTD</td>
<td></td>
</tr>
<tr>
<td>Friday 12 Nov</td>
<td>0830-1130</td>
<td>1330 Contract negotiations Discussions to be continued</td>
<td>BS+SFT</td>
<td>LVK</td>
<td></td>
</tr>
<tr>
<td>Monday 15 Nov</td>
<td>0830</td>
<td>AirQUIS data for report Start collecting traffic data again</td>
<td>BS</td>
<td>VTD</td>
<td></td>
</tr>
<tr>
<td>16 Nov</td>
<td>1030-1130 1330 -</td>
<td>Signing of Contract Reflab Data handling AirQUIS</td>
<td>BS+SFT</td>
<td>LVK, NTH</td>
<td>SFT</td>
</tr>
<tr>
<td>17 Nov</td>
<td>0830 -</td>
<td>Reporting and paper Discuss data collecting for emission inventories</td>
<td>BS</td>
<td>VTD, LSQT,NBQ, NTH</td>
<td></td>
</tr>
<tr>
<td>18 Nov</td>
<td>0830 -</td>
<td>AirQUIS data evaluation Status emission data collection</td>
<td>BS</td>
<td>VTD</td>
<td></td>
</tr>
<tr>
<td>19 Nov</td>
<td>0830 - 1700</td>
<td>1700 Discuss paper and reports Mr The to HCMC</td>
<td>BS</td>
<td>LVK, VTD</td>
<td></td>
</tr>
<tr>
<td>22 Nov</td>
<td>0830 – 1300</td>
<td>Install latest AirQUIS version Test database, run statistics for annual report Web discussions</td>
<td>TNT BS BS, TNT, TNT</td>
<td>VTD</td>
<td></td>
</tr>
<tr>
<td>23 Nov</td>
<td>0830 1000</td>
<td>Finalise presentation for BAQ Meeting VEPA, Dr Tung</td>
<td>BS</td>
<td>LVK, NDT</td>
<td>VTD</td>
</tr>
<tr>
<td>24 Nov</td>
<td>0830 – 0930 1030</td>
<td>Finalise report for BAQ Meeting with SwissContac Site visits Paper BAQ</td>
<td>BS</td>
<td>VTD, VTD</td>
<td></td>
</tr>
<tr>
<td>25 Nov</td>
<td>0830 1030</td>
<td>1330 Paper and data evaluation Testing GIS in AirQUIS Internet discussion continue Data for annual report</td>
<td>BS TNT TN BS</td>
<td>VTD, LSQT, NBQ, NTH</td>
<td></td>
</tr>
<tr>
<td>26 Nov</td>
<td>0830</td>
<td>Test new version of AirQUIS BS day off</td>
<td>TNT BS</td>
<td>VYD, NBQ, NTH</td>
<td></td>
</tr>
<tr>
<td>29 Nov</td>
<td>0830-1000</td>
<td>Data reporting Meeting about the Reference laboratory</td>
<td>BS, TNT BS, TNT</td>
<td>VTD,</td>
<td></td>
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</table>
Ho Chi Minh City Environmental Improvement Project
Air Quality Monitoring Component

<table>
<thead>
<tr>
<th>Day</th>
<th>Hr.</th>
<th>Assignment</th>
<th>NILU</th>
<th>HEPA/ DONRE</th>
<th>Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 Nov</td>
<td></td>
<td>Summarise input data models</td>
<td>BS</td>
<td>VTD</td>
<td></td>
</tr>
<tr>
<td>1 Dec</td>
<td></td>
<td>Emission data summary</td>
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<td>Reporting</td>
<td>BS,</td>
<td>VTD</td>
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<td>3 Dec</td>
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<td>Final meeting, summary</td>
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<td>VTD</td>
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NILU OR 4/2005
Appendix A2: Daily schedules

Memo

<table>
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<tr>
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<td>A summary of the project status as of November 2004.</td>
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<td>Mr. Khoa, Mr Dam, The Nguyen Thanh (TNT), Rolf Dreiem (RD)</td>
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<tr>
<td>Author</td>
<td>Bjarne Sivertsen</td>
</tr>
<tr>
<td>Date</td>
<td>November 2004</td>
</tr>
<tr>
<td>Reference No</td>
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1. Introduction

The following brief status of the HEIA project was prepared in connection with the Review team from the Norwegian Pollution Control Authority (SFT). The Review Team normally studies the progress reports for the Air Quality Monitoring System component. The team had planned meetings with HEPA and with the NILU project manager in Ho Chi Minh City in November 2004.

Four Missions to HCMC have successfully been undertaken and reported. Installations, training, data follow-up and reporting have been elements already in place at DONRE/HEPA. A follow-up programme including the establishment of a Reference laboratory as well as further training and institution building has been developed and presented to NORAD.

The following tasks and topics related to the project are briefly described in this memo:

- Instrument installations and audits
- System integration
- Database and planning tool (AirQUIS installation)
- Data collection and management
- Data assessment, interpretations and air quality status
- Input data for modelling (emission data collection)
- Capacity building
- Reference laboratory and further training

The project has been undertaken according to the original plans and contracts, and has also been kept within the estimated budget available.

2. Instrument installations and audits

The air quality monitoring network in HCMC has been installed completely and is now being operated adequately. The nine stations (4 from Danida and 5 from NORAD) as well as the site characteristics is given in the Table below.
A simplified Audit to the sites was performed on 20 April 2004. The result of this investigation indicated that the stations are kept well and that the operational procedures developed and trained by NILU are followed. A more detailed audit will be undertaken and reported in November 2004 by the NILU instrument expert.

### System integration

The existing data retrieval system, which was supported to DOSTE by the previous DANIDA project had to be integrated into the NORAD supported systems. This work has been undertaken successfully by NILU. HEPA/DONRE collects data from all the measurement stations once a day by using the Danida/OPSIS data retrieval system.

The manually operated system for generating Air Quality Index (AQI) values has been computerized by NILU as it was expressed by DONRE the need for reducing the manual work for generating these AQI values. The new automatic import module and the automatic AQI routine have been tested and accepted by DONRE.

### Database and planning tool (AirQUIS installation)

Installations of the database and planning system; AirQUIS at DONRE were undertaken in November 2003. Configuration and testing of the automatic import modules for retrieving air quality data on-line into the AirQUIS database was tested and verified.
Some improvements and modifications have been implemented between November 2003 and November 2004. Continuous communication between NILU and DONRE/HEPA has been the key to presently having a well operating system at HEPA: Mr Dam has been visiting NILU a second period for training in using the system as well as training in the use of dispersion models. The AirQUIS system is presently in daily use at HEPA.

The AirQUIS system is being used for several purposes. Most important to this point in time has been the import of air quality data, data statistics and assessment as well as the presentation of daily AQI values. However, HEPA is also preparing the system for impact assessment and planning.

The following status concerning the use of AirQUIS in HCMC may be summarised as follows:
- Administrative regions for HCMC are completed.
- Measurement station sites are completed.
- Stack coordinates are under verification.
- Road Nodes and Road links are still under updating.
- Grid: 40EW and 35NS with 1km resolution.
- Additional shape file for river is completed.

HCMC administrative region for 24 districts, 9 measurement stations, 45 stacks, 63 roads and a grid of 43 EW and 35 NS with 1 km resolution have been entered and verified.

HEPA is now also continuing the collection of input data for modelling. The most important and comprehensive task here is the development of an emission inventory for HCMC.

5. **Data collection and assessment**

Data collection is being followed up on a daily and weekly basis using the QA/QC procedures prepared by NILU. The field operations require that trained monitoring experts are visiting the stations every week. Other experts have been trained for using the data retrieval systems and the databases. QA/QC at all levels is an important issue that should be kept alive through regular auditing of the system, also in the future.

Some of the field operators or special assigned experts will be responsible for maintenance, repair and calibrations. The instruments in question contain:
- Automatic gas monitors
- Automatic ambient suspended particle monitors
- Automatic Weather stations

The establishment of the Reference and maintenance/repair laboratory will ensure that the programme will sustain good quality.
Air quality and meteorological data, which has been imported on a routine basis into the AirQUIS database, has been evaluated and presented. The validity and the content of these data as well as discussions on air quality assessment and understanding have been presented in several workshops.

Several errors were identified in the meteorological data already since the beginning of the NORAD financed project. Some of these errors have been corrected for, such as stability and wind directions. However, the instruments do still not operate adequately, and NILU has considered supporting HEPA with new sensors.

6. Data management, interpretations and air quality status
DONRE experts have now been trained to use the AirQUIS system for air quality management. The first introduction and training was undertaken during the seminar at NILU in March-April 2003. Mr Dam also visited NILU in February 2004 to receive training in the use of dispersion models, and the first model runs have successfully been presented.

Presentation of air quality data aimed at performing air quality assessment has been based on AirQUIS statistics. Presentations designed for documentation, state of the environment reports, monthly reports as well as annual reports has provided a need for using the AirQUIS system.

Monthly reports should include more statistics based on combinations of air quality data with meteorological data as well as frequency distributions and percentages of exceeding national standards. The generation of an annual report was discussed during Mission 4 and a layout developed during these discussions will be used to produce the first typical annual report at the end of the project (Mission 5).

7. Input data for modelling (emission data collection)
Preparations of input data to the models are under way. Based on specifications and templates given to DONRE during previous missions and as part of the model training sessions, DONRE experts are now collecting the data input needed.

A major part of this work is linked to obtaining emission data. Training in air pollution modelling, including preparation of input data, was given at NILU.

For point sources a total of 35 industries with coordinates have been collected. 45 stacks have been identified with 30 processes together with consumption data given as ton per year. 12 more stacks are under verification. The fuels included are: fuel oil, coal and diesel heavy oil. During the November Mission 2004 further discussions will be undertaken on how to obtain the necessary input data for estimating area sources such as small enterprises.
The traffic data is not easily available from e.g. traffic models operated in HCMC. Such models do not exist here. The collection of traffic data may therefore be more comprehensive than foreseen at the beginning of this project. We have presently divided the line sources into:

5 road classes classified as
1. Highway
2. Road between two towns/provinces
3. City centre street
4. Residential area street
5. Industrial area street

4 vehicle classes have been classified as
1. Lorry (heavy)
2. Van (light)
3. Bus
4. Motorbike

As of April 2004 a total of 77 road nodes with coordinates and 63 road links have been identified. This work continues during Mission 5 and beyond. The new NORAD project will support some of the further training and input needed from NILU to manage this task. One of the main input parameters is the collection of emission factors. Presently we have used factors collected from different project in Asia. Adjustments to the situation in HCMC and Vietnam should have been applied. However, studies of emissions from various vehicle classes in Vietnam have not started yet.

We have also realised that the project will have to support financially students to be engaged in further traffic counting. Mr Dam has prepared a schedule for the streets to be counted, and students will be paid to perform the counting according to the procedures developed by NILU.

8. Capacity building
Capacity building and training has been an important part of the NORAD financed HEIA project. There have been more needs for training identified as the project has proceeded.

The additional funds made available from NORAD will help to improve the operational capacity and the Quality Assurance part of the air quality monitoring programme. Some of these funds will also be used to improve the capacity concerning air quality management and abatement strategy planning.

Additional training will also be a key issue in the development of the Reference Laboratory at DONRE based on the additional funds provided by NORAD.
Further training may be needed in the preparation of air quality statistics and data interpretations even if this was one of the topics of Mission 3. The preparation of the annual report will be one way of proceeding on these topics.

For future needs it has been indicated that some support may be requested from NORAD by DONRE linked to institutional building and continuation of the existing NORAD project in HCMC. It seems that it may be difficult to obtain support for further instrumentation from NORAD in the future. DONRE may therefore first of all request support for institutional building from NORAD.

9. Reference laboratory and further training
As part of the maintenance and calibration procedures we identified already during our first Mission that the establishment of a Reference laboratory would be needed in HCMC. This laboratory is of crucial importance for keeping up a good quality monitoring system, which will meet international requirements.

General institutional strengthening through air quality lectures and seminars has been designed specifically for the needs for DOSTE/HEPA. It is vital for the project that the information and data collected from the monitoring stations is ultimately used to improve the air quality in HCMC. The programme will give valuable information on the air quality in HCMC and assessment on how the situation is compared with air quality standards. The additional training planned as part of this project will represent a good platform for preparing action plans to reduce emissions and air pollution impacts.

The continuation of the HEIA project through the newly funded Reflab project by NORAD will be an important contribution to ensure sustainability in the project already undertaken.
Appendix C

Task 3. Procure and install
# Delivery list

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Appendix E

Task. 5 Quality Assurance (QA/QC)
Appendix E1

MEMO

Data quality control at data retrieval

Data from monitoring stations with telephone lines are being retrieved every day. The daily control of the data is manually undertaken as soon as data have been retrieved. Data checks and data quality is being registered in a daily data validation manual. Whenever errors or strange data are identified from the database, the field operators will have to be notified, so that errors in calibrations or in instrument performance can be checked and corrected as soon as possible.

The following procedure has to be followed:

1. Poll the data (automatic or manual) from the station
2. Poll calibration data (zero/span) every week, evaluate levels, and report to operators.
3. Check the data in the data editor and verify the raw data in AirQUIS
4. Identify flags, change concentrations only if necessary (normally very seldom if ever!)
5. Check the concentration during the calibration hour once a week, and compare with the recorded concentrations. Verify validity of the calibration hour.
6. In case of errors or questions notify the station operator
7. Every week after station visits get the final calibrations results, and correct zero line (from zero correction) and trend using the calibration data.
8. In case calibration has been performed with span gas standards, get standard gas concentrations as well as reading on the monitor from station operators.
9. If readings deviate from gas standard concentration with more than 15%, adjust trend on data prior to calibration.

Record of data corrections

At the end of every month print the graph for every station and for every parameter (air pollutants and meteorology). The graphs and the data should be studied carefully to identify:

- Why are there missing data (could they be retrieved?)
- Are the zero lines real?
- Have calibration values been taken into account?
• Are there any further errors in the data that need to be flagged?

Correct final "errors" and finalise the database, included flags and remarks. Print the data again, and mark every parameter with Okay when finished.

Store printed graph in specific paper file and add comments etc..

At the end of the months also prepare statistics needed for the monthly report, and check that the statistics, such as 99 percentiles and average values seem to be correct.
Appendix E2

MEMO

Wind direction corrections

From the wind roses presented below it is clear that there is still an error in the wind direction data.

Both the months of January and August 2004 shows NO wind from northerly direction. This error has been present in the data since the measurements started after installations by the Danida project.

Wind direction, which should vary from 0 to 360 degrees, only range between 24 and 327 degrees, were corrected by introducing a simple linear correction factor:

$$DD_{\text{new}} = 1.18 \times DD_{\text{old}} - 29.1$$

This gave us a new database, which included the full range of wind directions.

Whether the error in the measurement were of exactly this character could not be verified. Until we know more, or manage to change the sensor completely, we will use this correction factor.
Appendix E3

MEMO

Lower temperature

To estimate the atmospheric stability using the temperature gradient, we will need the temperature at two levels. Temperature measurements are performed at the highest level in the tower at Doste. Temperatures from the lower level at the shelter about 3 m above the surface does not work. These data were also investigated during Mission 3 (see Appendix I, Mission 3 report). A temperature gradient was at that time estimated using a Bulk Richardson number approach, applying the measurements of radiation (indicator for heat flux), temperature at the tower, relative humidity (for estimating adiabatic temperature gradient) and wind speed:

$$\Delta T = 30^\circ\left(1.05 - 0.005 F_3\right)/100 - \left(0.007 G_3\left(H_3 + \left(1.05 - 0.005 F_3\right)/100\right)\right)/(E_3*30)$$

During Mission 5, however, only the wind speed and the upper temperature data were operating. We thus had to develop a simplified procedure for estimating a lower temperature. We assumed that the daytime lower temperature (during convective conditions) were about 0.5 degrees warmer than the temperature measured at 30 m. During nighttime conditions the lower temperature could be 1 to 2 degrees lower than the upper temperature. In addition we have assumed that the lower atmosphere is isothermal at sunrise and sunset.

To establish the lower temperature we may assume an exponential equation:

$$y = 8.4978 \exp(0.0418)$$

However, through testing we found that a linear equation:

$$y = 1.1515x - 4.5835$$

may work as well.

The figure shows a typical diurnal variation of the upper temperature (measured) and the lower temperature estimated.
Appendix F

Task 6. AirQUIS Training
How to create local Oracle database with AirQUIS

Operational Manual

November 2004
Author: The Nguyen Thanh
User Group: The HEPA Team
Introduction
This document describes how to install a local AirQUIS oracle database running with the AirQUIS application.

1. How to install local AirQUIS oracle database and AirQUIS application

a) Install local Oracle server for AirQUIS. Please see documentation for AirQUIS 2003 ORACLE server and client – Section Installation of ORACLE 9i server for AirQUIS.

b) Install all the software listed in the installation list from the Oracle Client 9.2.04 setup.

c) Add a ‘Net service Name’ for the Oracle database. Please see documentation for AirQUIS 2003 ORACLE server and client – page 26.

d) Create the AirQUIS database. Please see documentation for AirQUIS 2003 ORACLE server and client – Create ORACLE 9i database for AirQUIS.

e) Run the initial setup SQL-script CreateKernelAndInitData.sql.

f) Run the AirQUIS setup application e.g. AirQUIS_Setup_407.exe.

g) Run the latest Service Pack for AirQUIS when available from www.airquis.com.

2. Problem reporting procedure

If you encounter problems using the system and you are not able to solve them locally you should report the problems to NILU. Use the Procedure for Reporting Problems.
Appendix G

Task 7. Air Quality Modelling
Memo

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<tr>
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<td>Present the schedule for traffic counting in HCMC, November - December 2004.</td>
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<td>O-101143</td>
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SCHEDULE FOR TRAFFIC COUNTING

Team I: M. Hằng, Đúng  (Date 29/11 – 6/12/2004)

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<td>Trạm Thu Phí</td>
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<td>Cây xangstrom 153 Huỳnh Tấn Phát</td>
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<td>5</td>
<td>Dương 3/2</td>
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<td>6</td>
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<td>TTVH 97 NTMK</td>
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Team II: Liên, Quốc  (Date 07/12 – 13/12/2004)

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NILU OR 4/2005
**Ho Chi Minh City Environmental Improvement Project**

**Air Quality Monitoring Component**

---

**Team III: Đức, Huy**  
(Date 14/12 – 20/12/2004)

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**Team IV: T. Hàng, Tuân**  
(Date 21/12 – 28/12/2004)

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<td>7</td>
<td>Khu chế xuất LT</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Nguyễn Xí</td>
<td>Doàn giữa đường</td>
</tr>
<tr>
<td>9</td>
<td>Phan Đăng Lưu</td>
<td>Doanh trải quán dối (bên trái)</td>
</tr>
</tbody>
</table>

**Detailed schedule**

**Monday (29/11): Nguyễn Văn Linh (12 people/3 periods)**
- Period 1 (6h – 14h): T. Hàng (09185309175), 3 students
- Period 2 (14h – 22h): Quôc (0908479718), 3 students
- Period 3 (22h – 6h): Tuân (0908127730), 3 students
- Tinh lô 34 (6 people/3 periods)
  - Period 1 (6h – 14h): Liên (0918818881), 1 student
  - Period 2 (14h – 22h): M. Hàng (0989018020), 1 student
  - Period 3 (22h – 6h): Dung (0908250301), 1 student

**Tuesday (30/11): Trần Xuân Soạn (9 people/3 periods)**
- Period 1 (6h – 14h): T. Hàng (09185309175), 2 students
- Period 2 (14h – 22h): Quôc (0908479718), 2 students
- Period 3 (22h – 6h): A. Đức (0918206933), 2 students

**Phạm Thế Hiền (9 people/3 periods)**
- Period 1 (6h – 14h): M. Hàng (0989018020), 2 students
- Period 2 (14h – 22h): Liên (0918818881), 2 students
- Period 3 (22h – 6h): Huy ( ), 2 students

**Wednesday (1/12): 3/2 (17 people/3 periods)**
- Period 1 (6h – 14h): Quôc (0908479718), M. Hàng (0989018020), 4 students
- Period 2 (14h – 22h): Dung (0908250301), Liên (0918818881), 4 students
- Period 3 (22h – 6h): Tuân (0908127730), 4 students

**Thurdays (2/12): Nguyễn Thị Minh Khai (17 people/3 periods)**
- Period 1 (6h – 14h): T. Hàng (09185309175), Quôc (0908479718), 4 students
- Period 2 (14h – 22h): M. Hàng (0989018020), A. Đức (0918206933), 4 students
- Period 3 (22h – 6h): Dung (0908250301), 4 students

NILU OR 4/2005
Friday (3/12): Tinh lô 45 (12 people/3 periods)
Period 1 (6h – 14h): Liên (0918818881), 3 students
Period 2 (14h – 22h): Huy ( ), 3 students
Period 3 (22h – 6h): Quốc (0908479718), 3 students

Tân Thuận (6 people/3 periods)
Period 1 (6h – 14h): T. Hằng (0918509175), 1 student
Period 2 (14h – 22h): Tuân (0908127730), 1 student
Period 3 (22h – 6h): A. Đức (0918206933), 1 student

Monday (6/12): Huỳnh Tán Phát (12 people/3 periods)
Period 1 (6h – 14h): Liên (0918818881), 3 students
Period 2 (14h – 22h): Đúng (0908250301), 3 students
Period 3 (22h – 6h): Tuân (0908127730), 3 students

Lưu số 16 (6 people/3 periods)
Period 1 (6h – 14h): M. Hằng (0989018020), 1 student
Period 2 (14h – 22h): A. Đức (0918206933), 1 student
Period 3 (22h – 6h): Huy ( ), 1 student

Tuesday (7/12): Tân Kỳ Tân Quý (9 people/3 periods)
Period 1 (6h – 14h): Hằng (0918509175), 2 students
Period 2 (14h – 22h): Đúng (0908250301), 2 students
Period 3 (22h – 6h): Quốc (0908479718), 2 students

Tình lô 10 (9 people/3 periods)
Period 1 (6h – 14h): Liên (0918818881), 2 students
Period 2 (14h – 22h): Liêm (0918818881), 2 students
Period 3 (22h – 6h): A. Đức (0918206933), 2 students

Wednesday (8/12): Quốc lô 1 (12 people/3 periods)
Period 1 (6h – 14h): Liên (0918818881), 3 students
Period 2 (14h – 22h): Đúng (0908250301), 3 students
Period 3 (22h – 6h): Tuân (0908127730), 3 students

Lý Tự Trọng (6 people/3 periods)
Period 1 (6h – 14h): M. Hằng (0989018020), 1 student
Period 2 (14h – 22h): T. Hằng (0918509175), 1 student
Period 3 (22h – 6h): Huy ( ), 1 student

Thursday (9/12): Âu Cơ (9 people/3 periods)
Period 1 (6h – 14h): T. Hằng (0918509175), 2 students
Period 2 (14h – 22h): A. Đức (0918206933), 2 students
Period 3 (22h – 6h): Quốc (0908479718), 2 students

Lũy Bán Bích (9 people/3 periods)
Period 1 (6h – 14h): M. Hằng (0989018020), 2 students
Period 2 (14h – 22h): Liên (0918818881), 2 students
Period 3 (22h – 6h): Đúng (0908250301), 2 students

Friday (10/12): Kinh Dương Vương (17 people/3 periods)
Period 1 (6h – 14h): Liên (0918818881), M. Hằng (0989018020), 4 students
Period 2 (14h – 22h): A. Đức (0918206933), Huy ( ), 4 students
Period 3 (22h – 6h): Tuân (0908127730), 4 students

Monday (13/12): Tây Thanh (9 people/3 periods)
Period 1 (6h – 14h): T. Hằng (0918509175), 2 students
Period 2 (14h – 22h): A. Đức (0918206933), 2 students
Period 3 (22h – 6h): Đúng (0908250301), 2 students

Lưu số 2 (9 people/3 periods)
Period 1 (6h – 14h): Liên (0918818881), 2 students
Period 2 (14h – 22h): Quốc (0908479718), 2 students
Period 3 (22h – 6h): Huy ( ), 2 students
Tuesday (14/12):  Quốc Iổ 22 (12 people/3 periods)
Period 1(6h – 14h): Liên (0918818881), 2 students
Period 2(14h – 22h): M.Hàng (0989018020), 2 students
Period 3 (22h – 6h): Đăng (0908250301), 2 students

Nguyễn Văn Bór (6 people/3 periods)
Period 1(6h – 14h): T. Hạng (0918509175), 1 student
Period 2(14h – 22h): Tuân (0908127730), 1 student
Period 3 (22h – 6h): Huy ( ), 1 student

Wednesday (15/12):
Tinh Iổ 8 (8 people/3 periods)
Period 1(7h – 19h): Títán (0908127730), T. Hạng (0918509175), 2 students
Period 3 (19h – 7h): A.Đúc (0918206933), 4 students

Tinh Iổ 15 (8 people/3 periods)
Period 1(7h – 19h): M.Hàng (0989018020), Liên (0918818881), 2 students
Period 3 (19h – 7h): Quôc (0908479718), 4 students

Thursday:
Trương Chinh (17 people/3 periods)
Period 1(6h – 14h): Liên (0918818881), T. Hàng (0918818881), 2 students
Period 2(14h – 22h): Tuân (0908127730), Huy ( ), 4 students
Period 3 (22h – 6h): Đăng (0908250301), 4 students

Friday:  Quang Trung (17 people/3 periods)
Period 1(6h – 14h): Quôc (0908479718), M.Hàng (0989018020), 4 students
Period 2(14h – 22h): A.Đúc (0918206933), Huy ( ), 4 students
Period 3 (22h – 6h): Tuân (0908127730), 4 students

Monday (20/12):
Nguyễn Oanh (17 people/3 periods)
Period 1(6h – 14h): M.Hàng (0989018020), Liên (0918818881), 4 students
Period 2(14h – 22h): Đăng (0908250301), Huy ( ), 4 students
Period 3 (22h – 6h): A.Đúc (0918206933), 4 students

Tuesday (21/12):
Kha Văn Cân (9 people/3 periods)
Period 1(6h – 14h): T. Hàng (0918509175), 2 students
Period 2(14h – 22h): Tuân (0908127730), 2 students
Period 3 (22h – 6h): Huy ( ), 2 students

Tinh Iổ 43 (9 people/3 periods)
Period 1(6h – 14h): M.Hàng (0989018020), 2 students
Period 2(14h – 22h): Đăng (0908250301), 2 students
Period 3 (22h – 6h): Quôc (0908479718), 2 students

Wednesday (22/12):
Lương Đình Cúa (9 people/3 periods)
Period 1(6h – 14h): T. Hàng (0918509175), 2 students
Period 2(14h – 22h): Liên (0918818881), 2 students
Period 3 (22h – 6h): Đăng (0908250301), 2 students

Nguyễn Thị Diễm (9 people/3 periods)
Period 1(6h – 14h): M.Hàng (0989018020), 2 students
Period 2(14h – 22h): A.Đúc (0918206933), 2 students
Period 3 (22h – 6h): Tuân (0908127730), 2 students

Thursday (23/12):
Quốc Iổ 13 (12 people/3 periods)
Period 1(6h – 14h): Liên (0918818881), 3 students
Period 2(14h – 22h): T. Hàng (0918509175), 3 students
Period 3 (22h – 6h): Huy ( ), 3 students

Dương phủ KCX Linh Trung (6 people/3 periods)
Period 1(6h – 14h): M.Hàng (0989018020), 1 student
Period 2(14h – 22h): Quôc (0908479718), 1 student
Period 3 (22h – 6h): A.Đúc (0918206933), 1 student
Monday (27/12):  
Duong chinh KCX Linh Trung (8people/3 periods)
Period 1 (6h – 14h): T.Hang (0918509175), 2 students
Period 2 (14h – 22h): Dung (0908250301), 2 students
Period 3 (22h – 8h): Quoc (0908479718), 2 students

Nguyen Xi (8people/3 periods)
Period 1 (6h – 14h): M.Hang (0989018020), 2 students
Period 2 (14h – 22h): Dien (0918818881), 2 students
Period 3 (22h – 8h): Tuan (0908127730), 2 students

Tuesday (28/12): Phan Dang Luu (17 people/ 3 periods)
Period 1 (6h – 14h): M.Hang (0989018020), T.Hang (0918509175), 4 students
Period 2 (14h – 22h): A.Duc (091826933), Huy ( ), 4 students
Period 3 (22h – 8h): Dung (0908250301), 4 students
Appendix H

Task 8. Field Operations
Spare parts and gases

NILU checked and verified prices for spare parts and gases, which HEPA will have to obtain for operating the Danida supported stations.

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Quantity</th>
<th>Unit price USD</th>
<th>Total price USD</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PL00000022</td>
<td>30</td>
<td>64</td>
<td>1 920</td>
<td></td>
</tr>
<tr>
<td>013970000</td>
<td>2</td>
<td>927</td>
<td>1 854</td>
<td>NB: This is the complete pump unit with bracket, fittings, etc.</td>
</tr>
<tr>
<td>PL00000020</td>
<td>638</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PL00000011</td>
<td>5</td>
<td>132</td>
<td>660</td>
<td>NB: For the NOX pump supplied by us</td>
</tr>
<tr>
<td>005140000</td>
<td>02</td>
<td>1 049</td>
<td>2 098</td>
<td></td>
</tr>
<tr>
<td>KT000134</td>
<td>02</td>
<td>1 038</td>
<td>2 076</td>
<td></td>
</tr>
<tr>
<td>014961100</td>
<td>04</td>
<td>918</td>
<td>3 672</td>
<td></td>
</tr>
<tr>
<td>005260100</td>
<td>04</td>
<td>765</td>
<td>3 102</td>
<td></td>
</tr>
<tr>
<td>019400090</td>
<td>04</td>
<td>1 023</td>
<td>4 092</td>
<td></td>
</tr>
<tr>
<td>011440100</td>
<td>04</td>
<td>2 241</td>
<td>8 964</td>
<td>NB: The block is not sold as a separate item</td>
</tr>
<tr>
<td>KT0009905</td>
<td>04</td>
<td>329</td>
<td>1 300</td>
<td></td>
</tr>
<tr>
<td>PL00000001</td>
<td>30</td>
<td>61</td>
<td>1 830</td>
<td></td>
</tr>
<tr>
<td>OR0000001</td>
<td>60</td>
<td>8</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>014980100</td>
<td>04</td>
<td>918</td>
<td>3 672</td>
<td></td>
</tr>
<tr>
<td>KT0000041</td>
<td>03</td>
<td>647</td>
<td>1 941</td>
<td></td>
</tr>
<tr>
<td>014980000</td>
<td>02</td>
<td>728</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>011930090</td>
<td>03</td>
<td>1 605</td>
<td>4 815</td>
<td>NB: Priced no corrected</td>
</tr>
<tr>
<td>021070000</td>
<td>03</td>
<td>573</td>
<td>1 719</td>
<td></td>
</tr>
<tr>
<td>027430000</td>
<td>10</td>
<td>535</td>
<td>530</td>
<td></td>
</tr>
<tr>
<td>027990000</td>
<td>02</td>
<td>725</td>
<td>1 450</td>
<td></td>
</tr>
<tr>
<td>004020000</td>
<td>04</td>
<td>751</td>
<td>3 004</td>
<td></td>
</tr>
<tr>
<td>KT0000332</td>
<td>02</td>
<td>2 152</td>
<td>4 304</td>
<td>NB: 5 year warranty from 15. May 2002</td>
</tr>
<tr>
<td>009550000</td>
<td>04</td>
<td>1 950</td>
<td>5 850</td>
<td></td>
</tr>
<tr>
<td>015810000</td>
<td>05</td>
<td>206</td>
<td>1 030</td>
<td></td>
</tr>
<tr>
<td>005260100</td>
<td>03</td>
<td>381</td>
<td>1 143</td>
<td>NB: Not used in any instrument supplied by us</td>
</tr>
<tr>
<td>005260200</td>
<td>458</td>
<td>0</td>
<td>0</td>
<td>NB: For M400A supplied by us</td>
</tr>
<tr>
<td>015090000</td>
<td>03</td>
<td>1 287</td>
<td>3 861</td>
<td></td>
</tr>
<tr>
<td>Sum Total</td>
<td></td>
<td></td>
<td>62 669</td>
<td></td>
</tr>
</tbody>
</table>

Delivery time is 4 to 6 weeks. Prices are given exclusive freight.
The final costs are dependant on the USD exchange rate.

<table>
<thead>
<tr>
<th>Description</th>
<th>Size</th>
<th>Valve</th>
<th>Price USD (AL)</th>
<th>Price USD (AGA)</th>
<th>Price USD (BOC)</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 ppb NO</td>
<td>10 L</td>
<td>DIN 8</td>
<td>1 731</td>
<td>2 441</td>
<td>2 441</td>
<td>6.5</td>
</tr>
<tr>
<td>500 ppb NO</td>
<td>10 L</td>
<td>DIN 8</td>
<td>1 825</td>
<td>2 698</td>
<td>2 698</td>
<td></td>
</tr>
<tr>
<td>50 ppm CO</td>
<td>10 L</td>
<td>DIN 8</td>
<td>1 237</td>
<td></td>
<td>2 938</td>
<td></td>
</tr>
<tr>
<td>500 ppb NO in NO2</td>
<td>50 L</td>
<td>DIN 8</td>
<td>2 511</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Duration: 6 months 24 months 60 Months

The prices above are given from 3 different gas suppliers. These are: L'Air Liquid, AGA and BOC.
Delivery time is 6 to 8 weeks. Prices are given exclusive freight.

The final costs are dependant on the USD exchange rate.
Appendix J

Task 10 Air Quality Assessment
Appendix K

Task 11. Capacity building
Appendix L

Task 12. Administrative Meetings
Appendix L1

Minutes

Project meeting no. 9

Date: 16 December 2004

Participants: Bjarne Sivertsen (BS), The Nguyen Thanh (TNT), Rolf Dreiem (RD), Leif Marsteen (LM), Rune Ødegaard (RuO), Gunnar Jordfald (GJ)

Prepared by: B Sivertsen

Distribution: Participants, Paal Berg (PB)

HEPA (Le Van Khoa, Mr. Dam)

1 Agenda

1. Project status just now, economic success
2. The end of HEIA project- reporting
3. Audits to stations in HCMC, when and how?
4. The contract for the new project – name?
5. Procurement of instruments and equipment for Reflab. (see attached)
6. Installations and testing; needs, when, where?
7. Training needs assessment.
8. Time schedules and further work.
9. Other matters

1 Summary of meeting

2.1 Project status just now

The HEIA project was finalised during Mission 5 in November-December 2004. The plans have been followed and performed according to the contract. A contract for a follow-up project on the development of a Reference Laboratory and additional training was signed during a ceremony at DONRE in HCMC.

We are finalising the last two reports and this meeting is the preparation for the next phase. A final invoice for the HEIA project will be sent HEPA and NORAD before the end of this year.

2.2 The end of HEIA project- reporting

A complete list of reports was prepared for DONRE during Mission 5. The last two documents will be printed in January. Five Mission reports, several memos, minutes from meetings and manuals have also been issued as part of the project development. A few of these documents are also included on the HEIA CD.
2.3 Audits to stations in HCMC, when and how?

A preliminary audit to all stations in HCMC was performed during Mission 4. A final audit to be undertaken “at the end of the HEIA project” was indicated for the HEPA personnel. This station audit had to be postponed till the beginning of 2005.

This audit will then be combined with training for the new Reflab project and will be undertaken during the first Mission to HCMC in the new project.

2.4 The contract for the new project – name?

The contract for the new project was signed on 16 November 2004 at DONRE in HCMC. A good acronym for this project has yet not been identified. HEIA-2 is probably the easiest and best one.

The main tasks to be undertaken during HEIA-2 are:

1. Identify the physical location and features of the laboratory
2. Design the reference laboratory
3. Procure equipment
4. Test and verify equipment
5. Shipping of equipment
6. Install, verify and test the equipment in the laboratory
7. Develop training programme for maintenance, repair and calibration
8. Develop QA/QC programme related to Reference laboratory activities
9. Perform audits and train the ref-lab personnel
10. Update the database and collect input data
11. Meteorological data, training and improve instruments
12. Perform training in air quality assessment, seminar
13. Improve modelling capacity
14. Undertake impact evaluation
15. Prepare HEPA for undertaking abatement planning
16. Improve data dissemination and information

The facilities for the Reference laboratory will be identified, and the room prepared for installing the equipment for undertaking calibrations as well as maintenance and repair.

The project also includes training in QA/QC, repair and maintenance as well as further training in modelling and impact assessment work.

2.5 Procurement of instruments and equipment for Reference laboratory

During the meetings with HEPA we were informed about prices of instruments for the Reference Laboratory, which was given directly to HEPA from API. The prices were based on the specifications presented by NILU. The prices for deliveries of instruments directly to HEPA in HCMC seem to be cheaper than purchasing the equipment from via Norway (See Attachment 2).
NILU has received a request from HEPA to purchase directly. The probability of receiving instruments, which may be defect, is very limited. HEPA will have to assure that the warranty will take care of this.

The warranty period should start at the delivery day, which should be specified by HEPA: Depending on the availability of the reference laboratory facilities we will suggest that this date is 1 August 2004, so that Rolf may arrive in HCMC from medio August to install and train.

After a discussion of the different alternatives as well as the practical work to be undertaken the meeting decided to purchase directly from API to HEPA in HCMC.

2.6 Installations and testing; needs, when, where?

Based on the decisions taken in the meeting we will prepare the installations to be undertaken directly in HCMC. Rolf will have to be present from the moment the instruments are unpacked.

We have indicated in a mail to HEPA that to start the process we will have to undertake the following tasks:
1. Request API to give HEPA a formal and written quotation
2. Send a copy of this document to NILU as soon as possible
3. Ask API to specify that the guarantee/warranty period start at delivery, which HEPA should specify to a specific day, e.g. 1 August 2005!

To follow this procedures we will have to assure that the new Reflab laboratory has been checked and found okay, and that all benches, shelves and air condition etc is in place BEFORE the instruments are installed in the Laboratory.

Rolf will then support the unpacking, installations and see that necessary testing and training will be undertaken. (This will hopefully be Mission 2 at the end of August?)

2.7 Training needs assessment.

A training assessment programme will have to be developed both for the Reference laboratory and for the additional input to the institutional building related to air quality assessment and management.

NILU instrument experts will perform the necessary training for the operation of the Reference laboratory included additional QA/QC procedures. Together with the HEPA field operators NILU will also follow up calibration procedures and maintenance. NILU experts will undertake hand-on training in instrument maintenance, field calibrations, multi-point calibrations and repairs. Additional workshop and seminars will be planned and undertaken as part of the establishment of the Reference laboratory.

The objectives are also to improve the capacity building and to assure that the HEPA personnel will be able to conduct air quality assessment studies and air quality planning.
Within the limited budget NILU can together with the client define the strategic objectives of an Air Quality Management and planning System (AQMS), and support the selection of tools, modules and components to be used in a specific situation and for a defined area of interest. Training in the application of AirQUIS as a basis for performing abatement strategy planning will be prepared, but the work itself will have to be undertaken locally. NILU may, if wanted, participate in the process as part of the on-the-job training programme.

If the ADB project on “Air quality and health impact among the poor” will be a reality, NILU will support HEPA in addition to perform the necessary exposure estimates needed for this project. Further training will thus be needed both in HCMC and at NILU.

2.8 Time schedules and further work.

A total of 4 Missions have been planned during HEIA-2 project. The two main Missions to HCMC will be undertaken in August 2004 and in October/November 2005 depending upon the infrastructure and availability of laboratory in HCMC.

A short visits will also be paid to HCMC at the beginning of the project to design, prepare and identify the needs. At the end of the project there will be a summary workshop and discussions of results of the air quality assessment and planning work.

2.9 Other matters

HEPA and Mr Dam will be notified about the decisions and asked to start the process of procuring instruments directly from API to HEPA.
Attachment

3 Instruments for the new Reference Laboratory

There are two options for the procurement and installations of instruments for the new Reference Laboratory.
To purchase all instruments in Norway, from Furevik and install and test at NILU
To purchase directly from API to HEPA in HCMC. They seem to have received some favorable prices. (see below)

Ref lab deliveries

Inventory List

<table>
<thead>
<tr>
<th>Reference laboratory</th>
<th>Model (Example)</th>
<th>Cost 1000</th>
<th>Cost NILU</th>
<th>Cost US</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SO₂ monitor</td>
<td>API100</td>
<td>100</td>
<td>15 385</td>
<td>10 288</td>
<td></td>
</tr>
<tr>
<td>NOx monitor</td>
<td>API200</td>
<td>100</td>
<td>15 385</td>
<td>10 712</td>
<td></td>
</tr>
<tr>
<td>CO monitor</td>
<td>API400</td>
<td>90</td>
<td>13 846</td>
<td>7 780</td>
<td>Travelling standard</td>
</tr>
<tr>
<td>Zero air generator</td>
<td>API701</td>
<td>30</td>
<td>4 615</td>
<td>4 509</td>
<td></td>
</tr>
<tr>
<td>SO₂ cal. gas, 100 ppm, ref std.</td>
<td>NIST</td>
<td>14</td>
<td>2 154</td>
<td>1 815</td>
<td>incl. regulator</td>
</tr>
<tr>
<td>NO cal. gas, 100 ppm, ref std.</td>
<td>NIST</td>
<td>14</td>
<td>2 154</td>
<td>1 815</td>
<td>incl. regulator</td>
</tr>
<tr>
<td>CO cal. gas, 5000 ppm, ref std.</td>
<td>NIST</td>
<td>14</td>
<td>2 154</td>
<td>1 815</td>
<td>incl. regulator</td>
</tr>
<tr>
<td>Flow calibrator</td>
<td>BIOS DrvCal</td>
<td>25</td>
<td>3 846</td>
<td>6 347</td>
<td></td>
</tr>
<tr>
<td>PC with monitor</td>
<td>GW P5-133</td>
<td>10</td>
<td>1 538</td>
<td>1 538</td>
<td>Can be locally supply</td>
</tr>
<tr>
<td>PC Software</td>
<td>MS Office 95</td>
<td>5</td>
<td>769</td>
<td>2 000</td>
<td></td>
</tr>
<tr>
<td>PC printer</td>
<td>HP 682C DJ</td>
<td>2</td>
<td>308</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab. env., Air Pressure</td>
<td>Va P1B 201AD</td>
<td>10</td>
<td>1 538</td>
<td>1 538</td>
<td>incl. in Lab. env., Rel Hum.+Temp.</td>
</tr>
<tr>
<td>Lab. env., CO detector</td>
<td>SA 3000 SI</td>
<td>110</td>
<td>16 923</td>
<td>10 000</td>
<td>Can be locally supply</td>
</tr>
<tr>
<td>Rack for monitors (2 pcs)</td>
<td>EDR20086</td>
<td>10</td>
<td>1 538</td>
<td>1 538</td>
<td></td>
</tr>
<tr>
<td>Aircon+ furnitures etc</td>
<td>BACO</td>
<td>4</td>
<td>615</td>
<td>615</td>
<td></td>
</tr>
<tr>
<td>Laboratory items</td>
<td>Fittings, filters etc</td>
<td>5</td>
<td>769</td>
<td>769</td>
<td></td>
</tr>
</tbody>
</table>

| Total                 | 823             | 126 615   | 96 971    |         |

The NILU prices are the ones we indicated in the proposal. We may manage a better deal?

We will have to discuss procedures, security, insurance and other factors influencing the two alternatives, before we make a decision – in the meeting!
Appendix L2

Memo

<table>
<thead>
<tr>
<th>Title</th>
<th>Payment schedule and reports available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>To summarise the different reports presented during the HEIA project</td>
</tr>
<tr>
<td>Distribution</td>
<td>Mrs Tuyet Hoa, Mr. Khoa, The Nguyen Thanh (TNT)</td>
</tr>
<tr>
<td>Author</td>
<td>Bjørn Sivertsen</td>
</tr>
<tr>
<td>Date</td>
<td>November 2004</td>
</tr>
<tr>
<td>Reference No</td>
<td>O-101143</td>
</tr>
</tbody>
</table>

In the contract for the HEIA project the payment schedule was linked to some major milestones of the project. The following milestones were identified:

1. Planning, administration
2. Review existing monitoring programme – Inception report, Quarterly report 1 (QR 1)
3. Procurement of instruments, second quarterly report (QR 2)
4. Field installations finalised, status report (QR 3)
5. Establish data retrieval and QA/QC system, status report (QR 4)
6. AirQUIS installed and trained, first data presentations reported (QR 5)
7. Workshops and seminar on air quality assessment and abatement, (QR 6)
8. Data assessment, relative importance of sources (QR 7)
9. Plan of action for measures to be taken to reduce air pollution in HCMC (QR 8)
10. Capacity building and training, on-the-job, workshops (QR 9)
11. Further upgrading, improvements and understanding air quality, seminar (QR 10)
12. Information and data dissemination, evaluate Internet applications? (QR 11)
13. Final report

The payment schedule given in the Table below included the milestones presented above:

<table>
<thead>
<tr>
<th>Payment</th>
<th>Indicator, status</th>
<th>Month nr.</th>
<th>1000 NOK</th>
<th>1000 NOK accumul</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Planning, administration</td>
<td>1</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>2</td>
<td>Review existing monitoring programme – Inception report, Quarterly report 1 (QR 1)</td>
<td>3</td>
<td>500</td>
<td>800</td>
</tr>
<tr>
<td>3</td>
<td>Procurement of instruments, second quarterly report (QR 2)</td>
<td>6</td>
<td>2 500</td>
<td>3 300</td>
</tr>
<tr>
<td>4</td>
<td>Field installations finalised, status report (QR 3)</td>
<td>10</td>
<td>600</td>
<td>3 900</td>
</tr>
<tr>
<td>5</td>
<td>Establish data retrieval and QA/QC system, status report (QR 4)</td>
<td>12</td>
<td>350</td>
<td>4 250</td>
</tr>
<tr>
<td>6</td>
<td>AirQUIS installed and trained, first data presentations reported (QR 5)</td>
<td>15</td>
<td>500</td>
<td>4 750</td>
</tr>
</tbody>
</table>
A summary of the reports that have been developed during the project is presented in the Table below. These reports as well as some background material presented to the DONRE/HEPA experts have also been made available on a CD presented to DONRE.

<table>
<thead>
<tr>
<th>Report</th>
<th>Project title (short version)</th>
<th>NILU report</th>
<th>Dated</th>
</tr>
</thead>
<tbody>
<tr>
<td>QR 3</td>
<td>Mission 2, Procurement and installations performed.</td>
<td>OR 02/2003</td>
<td>Nov. 2002.</td>
</tr>
<tr>
<td>QR 4</td>
<td>Field installations and Passive sampling of NO2 and SO2 at selected sites in Ho Chi Minh City.</td>
<td>OR 15/2003</td>
<td>April 2003.</td>
</tr>
<tr>
<td>QR 7</td>
<td>Seminar at DOSTE and at NILU, several training memos available</td>
<td>F 13/2002 + F Reports</td>
<td>April 2002.</td>
</tr>
<tr>
<td>QR 9</td>
<td>AirQUIS Workshop no. 1 held at NILU, Kjeller (Norway).</td>
<td>OR 20/2003</td>
<td>31 March – 11 Apr 2003</td>
</tr>
</tbody>
</table>

Several memos, minutes from meetings and manuals have also been issued as part of the project development. A few of these documents are also included on the HEIA CD.
Appendix L3

Minutes of Meeting with Swisscontact

<table>
<thead>
<tr>
<th>Title</th>
<th>Meeting with Swisscontact at HEPA 24 November 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>Mr Lukas Heer (Swisscontact Hanoi), Mr. Roy Eugster (Zurich), Mr. Reto Schupbach (Zurich), Mr. Vo Thanh Dam, Mr. Bjarne Sivertsen (BS) and Mr. The Nguyen Thanh (TNT),</td>
</tr>
<tr>
<td>Distribution</td>
<td>TNT, LV Khoa, Mission 5 report</td>
</tr>
<tr>
<td>Author</td>
<td>BS</td>
</tr>
<tr>
<td>Date</td>
<td>25 November 2004</td>
</tr>
<tr>
<td>Reference No</td>
<td>O-101143</td>
</tr>
</tbody>
</table>

Swisscontact had asked for a meeting with HEPA to receive information of the air quality monitoring and management programme developed and operated in HCMC.

Swisscontact, the Swiss Foundation for Technical Cooperation (www.swisscontact.org) has been mandated by the Swiss Agency for Development and Cooperation SDC (www.deza.admin.ch) to implement the first phase of the Swiss-Vietnamese Clean Air Program (SVCAP).

The overall goal of SVCAP is to contribute to the prevention of a possible further degradation of the air quality in Hanoi and surrounding. The purpose of the first phase (SVCAP-I, 09/04 – 12/07) is to support the creation of favourable conditions for the reduction of air pollution by means of the definition and implementation of an integral air quality management system, focusing on Hanoi and surrounding.

Lukas Heer is the Project Manager of the Swiss-Vietnamese Clean Air Program (SVCAP), a quite new, Swiss funded long-term initiative which aims at supporting the Vietnamese Government at National and city level (focus in the first phase 2004 - 2007 is on Hanoi) in preventing the further deterioration of the air quality in Vietnam and its urban centres.

SVCAP is currently conducting a situation analysis on the availability and quality of air pollution data in Hanoi. Based on the situation analysis, they plan to come up in December with a concept for the future air quality monitoring system in Hanoi, included regular emission inventories (and dispersion models, at a later stage), as the base for subsequent implementation steps in line with program objectives. Based on our preliminary assessment, capacity building is likely to play an important role within the program.

Through four components, SVCAP-I will focus on capacity building and institutional strengthening, resulting in the long-term in a sustainable implementation of air pollution reduction measures.
The Swiss Agency for Development and Cooperation SDC, through Swisscontact, acting as its implementation agency, contributes up to CHF 3'417'000.- (approx US$ 2'500'000.-) as follows:

- Fully-fledged project management office over the whole project period and Swisscontact management/expert team, consisting of one full-time Project Manager, four full-time Program Officers and support staff (in-kind contributions)
- Technical assistance in form of international and national/regional consultancy (in-kind contributions)
- Direct financial contributions to the SVCAP-I program activities

The Vietnamese partners provide mainly in-kind contributions with regard to human resources, data and information and working infrastructure.

We stressed and were supported by Mr Heer that it will be important to closely coordinate future activities from the HEPA side and from the Swiss side, in order to avoid overlaps and rather create synergies, if possible. They are looking into the possibility of creating a database for air quality planning and are investigating the projects already undertaking by different agencies such as NORAD, Danida, CIDA, JICA and US-AED. The World Bank initiative in the transport sector will also be considered.

The Swiss experts were very interested in the emission inventory, which presently is being developed for HCMC. They have that as a major priority on their list for activities in Hanoi.
Appendix L4

Memo

<table>
<thead>
<tr>
<th>Title</th>
<th>MONRE/VEPA project for integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>Discuss and propose HEPA/NILU input to Hanoi and Vietnam National air quality integrated programme</td>
</tr>
<tr>
<td>Distribution</td>
<td>Mr. Khoa, Mr Dam, The Nguyen Thanh (TNT)</td>
</tr>
<tr>
<td>Author</td>
<td>Bjarne Sivertsen</td>
</tr>
<tr>
<td>Date</td>
<td>November 2004</td>
</tr>
<tr>
<td>Reference No</td>
<td>O-101143</td>
</tr>
</tbody>
</table>

Dr. Hoang Duong Tung, Director for the Centre for Environmental Monitoring, Data and Information (CEMDI) at VEPA/MONRE and Mr. Thai Minh Son from MONRE in Hanoi visited HEPA HCMC on 23 November 2004 to discuss the NORAD financed HEIA project and possible future co-operation between HEPA and VEPA. They were informed about the work undertaken as part of the NORAD project and were impressed and interested in a follow-up programme.

After the meeting it was clear that VEPA and HEPA have the intention for a close cooperation regarding utilising the competence and experience gained by HEPA through the NORAD funded project.

We have indicated in a mail to VEPA that a project proposal could be established based on the success from the air quality management project (HEIA) in HCMC. By providing Hanoi the necessary competence transfer from HCMC for institutional building in Hanoi, we believe, will give this proposal a good platform for seeking for funds e.g. from NORAD.

We have proposed an approach for VEPA regarding preparing a the proposal to be discussed with NORAD. The main activities may be concentrated at capacity building including:

- Training in understanding the Air Quality Management
- Air Quality Management based on DPSIR framework
- Monitoring network design
- How to maintain and perform quality assurance work on the existing measurement stations
- How to integrate existing measurement data from the existing stations in Hanoi into a centralized measurement database
- QA/QC and data quality procedures; improving data flow and air quality data availability
- Air quality statistics and reporting procedures
- Dissemination of air quality information to the public using online data and Internet techniques
Air quality management at different levels and between authorities starting with VEPA in Hanoi and HEPA in HCMC
The project will include the establishment of an Air Quality Management Platform to meet the requirements of a Centralised Air Quality Monitoring Network for Hanoi and later for Vietnam.

A main objective of these efforts for integrating all activities related to air pollution investigations, monitoring and management in Hanoi will be to assure that activities will not be duplicated and that all parts are co-ordinated to reach the same goal.

The first phase of the project will aim at handling the existing measurement stations through the establishment of:

- Routines for operating the monitoring network
- The use of an Air Quality Management System in Hanoi
- An Online Air Quality Dissemination System using Internet

As part of the procedure we will have to evaluate the HEIA project in HCMC as seen from VEPA in Hanoi. A letter of intent for cooperation between VEPA and HEPA will have to be prepared and objectives, methods, project organisation and time schedules will be prepared.

The experience established at HEPA in HCMC may provide services and support concerning:

- Design operation and management of air monitoring network
- Maintenance and quality assurance of data from the measurement network
- Establishment of an air pollution emission inventory
- Performing air quality assessment using state-of-the-art air quality management system
- Publishing air quality information using online air quality dissemination system on Internet
- Reference Laboratory for maintenance and repair of measurement equipments, dynamic calibration, verification of measurement standards and methods etc.

To get an overview of data from the measurement stations, HEPA can assist VEPA to evaluate the data. To be able to perform the evaluation, HEPA need to retrieve data.

Since there is no money at the moment, HEPA has proposed the following solution:

1. Can VEPA export data into ASCII-file from the data loggers and/or data retrieval systems in the measurement stations?
2. Transfer the exported ASCII-file from the measurement stations to HEPA preferably by FTP. If not possible, then E-mail can be used.
3. HEPA will use the automatic import module in AirQUIS to import the exported ASCII-files from VEPA.
4. HEPA will evaluate and comment the quality of the measurement data for VEPA.
Summary:
- VEPA is responsible for exporting data into ASCII-files and transfer these to HEPA.
- HEPA will import the measurement from the ASCII-files and evaluate the data for VEPA.

In short, if VEPA manage to get funds then the new project will introduce new data loggers, automatic data acquisition system for getting data automatically to a centralised database.

In the mean while, please provide HEPA with the following information, if possible:
1. What kind of the instruments, data loggers, modems and data retrieval software including PC-equipment and operative system (if any) exist at the stations?
2. The possibility of connecting to the stations using modem
3. What components, values and units do the data loggers collect?
4. What are the routines for retrieving the measurement data?
5. What kind of quality assurance routines exists at the stations (station log, instrument log, calibration, spare parts and consumables)
6. Who undertakes repair and dynamic calibration of the instruments? Do you have maintenance contracts with instrument suppliers?

The file contains the following structure:
- Col 1 - Date (the format is flexible e.g. yymmdd)
- Col 2 - Time (the format is hh:mm). The time step is 1 hour and must be continuously meaning 24 values for each day. No measurements can be filled with nothing (blank) or 0, dependent on how the instruments and data loggers are configured.
- Col 3 - Values from a specific component
- Col 4 and so on - Values from other components from the same station. Quality Control (QC) flag for each component can also be included in this file as columns e.g. in between or at the end of columns. AirQUIS does provide automatic QC-flag with specific predefined rules from the user and QC-level when importing measurement data.

Please specify in a separate document the name and unit of the columns in the document. If you are including the QC-flags please also specify the flag types. You can also provide a file for each component, but it's more efficient to export all the components in one file for each station.

It's important that all the columns have fixed positions, because The Automatic Module in AirQUIS will assign the properties (e.g. Date, Time, Values from the columns in the file).
In a comment from Dr Tung he states that:
VEPA role is to manage and support monitoring stations at national wide. From this point of view, we try to develop a common standard, methodology and use a common tool/software at provincial and central level. It could help all of us to manage, share information, data within national network. Therefore we would like very much to expand NILU/HEPA experience in air monitoring and inventory, data management.

May I suggest that at the beginning, NILU-VEPA jointly develop a proposal on mentioned topics, particular on data management, software and training for air monitoring stations? After that we could implement first in Hanoi and some other air stations belong to VEPA network. If a proposal approved, during implementation phase, we can use HEPA people as resource person/local consultants/expert to carry out a project.
Appendix L5

Memo

<table>
<thead>
<tr>
<th>Title</th>
<th>Tasks to be undertaken at HEPA after Mission 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose</td>
<td>List of tasks that HEPA will have to undertake after Mission 5 to HCMC.</td>
</tr>
<tr>
<td>Distribution</td>
<td>Mr. Khoa, Mr. Dam, The Nguyen Thanh (TNT), Rolf Dreiem (RD), Leif Marsteen (LM)</td>
</tr>
<tr>
<td>Author</td>
<td>Bjarne Sivertsen (BS)</td>
</tr>
<tr>
<td>Date</td>
<td>November 2004</td>
</tr>
<tr>
<td>Reference No</td>
<td>O-101143</td>
</tr>
</tbody>
</table>

The following tasks have to be undertaken at HEPA after Mission 5:

1. Correct all air quality data for October and November 2004 and prepare new printout
2. Update the quality assurance file with monthly printouts every month after corrections and flagging, printed versions into the book
3. Produce lower temperatures for DOSTE station in the future, and check that the database is complete for 2004
4. Correct wind directions at Doste station according to procedures given by BS
5. Run monthly wind roses from Doste station, import to a word file and mail to NILU,
6. Get monthly wind roses from the Meteorological service in HCMC, and compare to the Doste wind roses
7. Generate 24 hour average PM$_{10}$ concentrations and store in database
8. Generate moving 8-hour average CO concentrations and store in database
9. Change and correct the stack co-ordinates in AirQUIS
10. Visit all Districts to discuss with responsible environmental experts in each District the locations of industrial areas, type of industries and possible information for emission estimates,
11. Identify industrial areas and locate them in the GIS maps (as industrial shapes) in AirQUIS
12. Continue traffic counting and import information to AirQUIS and send information to NILU
13. Perform more model tests and send results to NILU (to TNT & BS)
14. Finalise the HEPA Web site (VTD, TNT)
15. Support the import of traffic area source emissions estimated from population distributions in each Ward (BS/VTD)
16. In the future prepare monthly statistics in summary report to be specified by BS (VTD)
17. Prepare facilities for the Reference laboratory
**REPORT SERIES**
SCIENTIFIC REPORT

<table>
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<td>ISSN 0807-7207</td>
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<td>Bjarne Sivertsen</td>
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<td>O-101143</td>
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<td>Air Quality Monitoring Component</td>
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<td>Mission 5, November 2004; Status report (QR10-11), Understanding air quality and data dissemination</td>
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<tbody>
<tr>
<td>Bjarne Sivertsen and The N. Thanh</td>
<td>*</td>
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<table>
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<td></td>
</tr>
<tr>
<td>Postboks 8034 Dep.</td>
<td></td>
</tr>
<tr>
<td>0030 OSLO, Norway</td>
<td></td>
</tr>
<tr>
<td>Ho Chi Minh City, Dep. of Science, Technology and Environment</td>
<td></td>
</tr>
<tr>
<td>244 Dien Bien Phu St., Distr.3</td>
<td></td>
</tr>
<tr>
<td>Ho Chi Minh City, Viet Nam</td>
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<table>
<thead>
<tr>
<th>ABSTRACT</th>
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<tbody>
<tr>
<td>Mission 5, as part of the NORAD financed HEIA project, was undertaken to HCMC from 4 November to 4 December 2004. The air quality monitoring and management system has now been established and is being operated by trained HEPA/DONRE experts. During Mission 5 we signed an agreement for the establishment of a Reference Laboratory and continued institutional building. NILU upgraded the AirQUIS system and we continued training the local experts. Data quality controls of air quality and meteorological data have been performed, and we continued collecting emission data for modelling purposes. During the mission we also prepared a paper on air quality in HCMC, which also will serve as a state of the environment report.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<tr>
<td>KEYWORDS</td>
<td>Air quality monitoring</td>
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</tbody>
</table>

ABSTRACT (in Norwegian)

---

*Classification

- A Unclassified (can be ordered from NILU)
- B Restricted distribution
- C Classified (not to be distributed)