Department of Natural Resources and Environment (DONRE) Ho Chi Minh City

NORAD
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NORWEGIAN AGENCY FOR DEVELOPMENT COOPERATION

Ho Chi Minh City Environmental Improvement Project
Air Quality Monitoring Component

Mission 3, November 2003; Status report (QR6), AirQUIS installed and trained

NILU
Norwegian Institute for Air Research

HCMC EIA
Ho Chi Minh City
Environmental Improvement Project
Air Quality Monitoring Component

NILU: NILU OR 84/2003
REFERENCE: O-101143
DATE: DECEMBER 2003
ISBN: 82-425-1521-2

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Mission 3, November 2003; Status report (QR6), AirQUIS installed and trained

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List of Abbreviations

ADACS	Automatic Data Acquisition System
CO	Carbon monoxide
CEN	European Committee for Standardisation
CLRTAP	Convention on Long Range Transport of Air Pollutants
DANIDA	Danish International Development Assistance
DONRE	Department of Natural Resources and Environment
DOSTE	Department of Science, Technology and Environment.
EDC	Environmental Data Centre at DOSTE
HEIA	**H**o Chi Minh City **E**nvironmental **I**mprovement Project **A**ir Quality Monitoring component
HEIP	Ho Chi Minh City Environmental Improvement Project.
ISO	International Organization for Standardization
NILU	Norwegian Institute for Air Research
NO_2	Nitrogen dioxide
NORAD	Norwegian Agency for Development Cooperation
MPI	Ministry of Planning and Investment
Pb	Lead
PM_{10}	Particulate matter with diameter Less than 10 micrometer
$PM_{2,5}$	Particulate matter with diameter Less than 2,5 micrometer
PIU	Project Implementing Unit (PIU)
QA	Quality Assurance
QC	Quality Control
SO_2	Sulphur dioxide
SOP	Standard Operating Procedures
SVN	Schmidt Vietnam Co. Ltd.
UNOPS	United Nations Office for Project Services

1 Task 1. Review the system

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 **H**o Chi Minh City **E**nvironmental **I**mprovement Project **A**ir 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 build on the existing developments funded by Danida. Evaluations of existing equipment have formed the basis for identifying further work, sites, instrumentation and the development of a total air quality planning system.

The project is being undertaken in a number of tasks and subtasks. The installation of field equipment was undertaken as part of Mission 2 (Sivertsen et al. 2002). Training in the use of the GIS based database and planning system AirQUIS was undertaken at NILU in March-April 2003. (Laupsa and Johnsrud, 2003)

Following the training at NILU a first version of AirQUIS was installed at one of the DONRE laptop computers. The final installation in HCMC was scheduled for Mission 3. Mission 3 included the following main tasks:

- Purchase and install new computers at the computer centre
- Install the HCMC version of AirQUIS already prepared from NILU

- Import all air quality and meteorological data
- Perform training in the application of AirQUIS
- Develop Air Quality Index procedures, and data reporting
- Present training workshops in meteorology and air quality data assessment
- Start collecting emission data for future modelling purposes
- Undertake training in emission data collection
- Assess further training needs, update status on the Reference Laboratory and maintenance work
- Perform on-the-job training.

The daily schedule for Mission 3 is presented in Appendix A1.

1.2 Administrative meetings

Project meetings have been held at NILU to follow-up the project. Minutes from some of these have been sent to NORAD and to SFT. Two of the minutes from these meetings are presented in Appendix A2 and Appendix A3.

During Mission 3 daily meetings were held with the DONRE counterpart to update the status and discuss the present work and progress.

Various meetings were also called to discuss the status of the Reference Laboratory, which is needed at DONRE to keep up the quality of the measurements. It is assumed that this laboratory, which also will undertake calibrations, maintenance and repair, will be of great importance for keeping the programme sustainable.

A letter requesting funds from NORAD for this development was sent to NORAD on 25 November 2002. (See Appendix H7 of Mission Report 2). The request has been evaluated by NORAD and is presently being evaluated by the Ministry of Planning and Investment (MPI) in Vietnam. It is assumed that the request will come back to NORAD from MPI at the end of the year.

DOSTE also forwarded a letter with positive references to the NORAD project reconfirming the need for a Reference laboratory (see Appendix A4).

2 Task 2. Design and update

2.1 Monitoring sites operated

The five NORAD financed air quality monitoring sites were installed and set in operation during Mission 2 in November 2002. DONRE is thus presently operating 9 air quality stations in HCMC. (See Chapter 8)

The monitoring sites and their positions on the map is presented in Appendix B1. A summary of ID, station number, name and co-ordinates is presented below.

The sites have been classified according to their microenvironment. Four sites are characterised as traffic stations: 1, 2, 5, 6. Three sites are classified as urban background stations: 4, 7, 9. The sites 3 and 8 are both influenced by industrial emissions but are located in residential areas.

Station			**UTM 84 N**	
ID	Code	Name	**X coordinate (m)**	**Y coordinate (m)**
1	DO	DOSTE	684,430	1,192,220
4	TS	Tan Son Hoa	682,830	1,193,930
3	TD	Thu duc	693,640	1,199,790
2	HB	Hong Bang	681,620	1,189,460
7	ZO	Zoo	686,420	1,193,370
9	QT	Quang Trung	677,940	1,200,080
8	D2	District 2	691,160	1,193,510
5	TN	Thong Nhat	680,690	1,193,530
6	BC	Binh Chanh	674,500	1,183,000

3 Task 3. Procure and install

3.1 Specifications

All air quality instruments and following equipment was delivered to DONRE during Mission 2 in November 2002. A complete list of deliveries was presented in Appendix C1 of the Mission 2 report.

Specifications of the computer equipment needed to operate the GIS based air quality database and planning system was also specified in Mission 2 report, Appendix D1b.

Before arrival of the NILU experts during Mission 3 we provided DONRE with the following:

- AirQUIS server
- AirQUIS documentations
- Backup unit

NILU also specified the server and the client on request from DONRE.

Client-PC:

- The client-PC should be P4 (assuming that the CPU speed has changed since our last update. Anyway, don't go for the fastest CPU, because it's the most expensive one).
- The next important things are: 512 MB RAM, Windows XP English and one standard hard disk 40 GB.
- One 19" monitor for the Client-PC

Server:

- One 19" monitor for the server.
- Please get an English keyboard for the server.

The proforma invoice as presented by NILU in October 2003 is shown in Appendix C1.

The total cost of equipment delivered to DONRE during the NORAD project was requested from the Project Implementation Unit. The total estimated cost was estimated at 3,194 million NOK or 4, 563 US $ as presented in Appendix C2.

A list of deliveries is presented in Appendix C3.

3.2 AirQUIS installations

The computers were installed at the "preliminary" established computer centre at DONRE. The institution is about to move away from DOSTE, and final laboratories and offices have not been obtained yet.

The installations were undertaken on 3 –5 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.

A summary of the installations and technical implementation of the AirQUIS system is presented in Appendix C4.

4 Task4. Assure system integration

4.1 Identify existing data collection system

The Enviman ComVisioner had been tested at NILU in August-September 2002. This was necessary to obtain one consistent monitoring system to be operated by DONRE.

4.2 Evaluate OPSIS system and add new licences

Five new licences for the OPSIS data retrieval system were obtained to ensure that there would be no changes in the data retrieval system relative to what had been installed by the Danida project.

The EnviMan data retrieval system was updated during Mission 2 to receive data from 5 more stations. A new version of the EnviMan ComVisioner was thus installed. During Mission 3 we assured that the complete system would be used to retrieve data from all 9 sites in HCMC.

To reduce the possible down time whenever the system should break down, a routine for cloning of the PC was also established during Mission 2. The specifications for new server and clients for AirQUIS to meet the integration requirements are presented in Appendix D

4.3 Prepare interface

As part of the preparation of the interface between the OPSIS system and AirQUIS NILU had to configure EnviMan to automatically produce daily measurement files in EN2-format for the AirQUIS import module.

Existing reporting routines in Excel Macro also had to be updated to include the new measurement stations. No major modifications were implemented to the existing reporting procedures, as it was agreed that the new reporting procedures using the new AirQUIS version would be more efficient.

As part of the implementation of AirQUIS at DONRE we also had to prepare automatic routines for the daily report of the Air Quality Index (AQI) and AQI classifications. (See Chapter 9)

5 Task 5. Quality Assurance (QA/QC)

5.1 Design QA/QC

To assure that the measurements of air quality in HCMC meet the international standards a Quality Assurance system was developed and presented during Mission 2. The system was based on the DANIDA project. However, new instruments such as the Eberline PM_{10} monitor have been described in details and operating procedures (SOP) for the quality assurance have been developed.

5.2 Prepare SOP

As part of the NILU routines we will assure that some typical Standard Operating Procedures (SOPs) are available. In field operations the following routines should be established:

- Station Manuals including (SOP) for instrument installations, maintenance, controls etc.,
- Zero span checks and calibration routines,
- Station history logbook available.

All these procedures were established during Mission 2, and it seem that the staff and operators at DONRE are presently following them.

5.3 Quality control at data retrieval

After installation of AirQUIS all data will be automatically entered into the AirQUIS database, where some automatic data control will delete obvious errors in the data. This will immediately improve the database that e.g. is being used to estimate the daily Air Quality Index.

The daily control of the data should still also be manually undertaken. Using the AirQUIS database it is easy to print time series or to perform simple statistical calculations in order to control the data.

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.

Occasionally data cannot be retrieved from the stations due to communication problems. For instance on 18 November 2003 data from all stations except for District 2 could be retrieved into AirQUIS. On Monday morning 24 November, however, after a heavy rainfall over HCMC, data from only 4 out of 9 stations could be retrieved. This was due to communication problems; telephone lines or modem errors. Data were available from DOSTE, HongBang, Thong Nhat and Zoo District 1.

When developing the Air Quality Index in this situation we had a problem using all stations. This problem will be looked into and solved.

5.4 QA presentation and training

For the air quality monitoring and field operations hand-on training was performed during the installations in HCMC in November 2002. We still hope to be able to follow up this training when and if a Reference Laboratory will be installed at DONRE. More detailed training will be a major part of the establishment of a calibration and maintenance laboratory at DONRE.

The QA/QC officer appointed by DONRE, Mr. Vo Thanh Dam also was supported by the project to undertake training at API in California. Teledyne -API company organised a training class for better understanding the API instrument maintenance and repair (level II). Te course was given in August 2003 in San Diego, USA. The training schedule is presented in Appendix E.

Hand-on training in using the daily AirQUIS presentations as part of the daily data quality assurance was also given during Mission 3. These “quality by finger” routines will be improved by using the procedures.

6 Task 6. Install AirQUIS

6.1 Prepare AirQUIS platform and GIS

The computers delivered as part of the AirQUIS platform were presented in Chapter 3.1. The server with clients were already prepared and tested before the AirQUIS workshop and seminar at NILU in March-April 2003.

The installation included the total system with Server, Client, OS, Oracle and AirQUIS including automatic import from EnviMan files.

NILU installed the Oracle database and configured the AirQUIS database on the server. The PC client was installed with one AirQUIS client licence. The PC server and the client PC was then connected to the existing network in the DONRE data centre. (See also Appendix C4.)

All AirQUIS deliverables are listed in Appendix C3.

Some simple tests were performed with air quality data from HCMC. All statistics and data preparation will be tested before, during and after installations at DONRE. It will be important that the DONRE experts actually use the system on a daily basis, to identify problems and make improvements possible.

6.2 Establish final GIS

The HCMC version of AirQUIS was established and tested at NILU with GIS data and air quality data received from DONRE. The HCMC platform was prepared in January to March 2003, and all digital maps available were installed and modified to fit the GIS database.

The co-ordinate systems on the maps that we received from DONRE during Mission 1 were inconsistent. All these problems were solved before installing the AirQUIS at DONRE in HCMC. The GIS maps as appearing in the HCMC AirQUIS database is presented in Appendix F1.

6.3 Develop and test interface

Mr The N Thanh had already prepared the interface between the OPSIS data retrieval system and AirQUIS. The existing reporting routine was updated in Excel Macro to include the new measurement stations.

Air quality data from the four Danida monitoring sites for 2001 were collected by NILU during Mission 1 and tested for AirQUIS applications. During Mission 3 all data from 2003 were imported to the AirQUIS database. From 6 November data were retrieved from the Danida stations as well as from the five NORAD stations automatically.

6.4 Hand-on-training

Hand-on training was given to the DONRE experts during the installation of the AirQUIS platform. During Mission 3 the training received at NILU in March-April 2003 was updated. The seminar given at NILU is presented in Chapter 11.

During Mission 3 Mr. The performed training of the Automatic Import Module and was responsible for the repetition of the AirQUIS training from Norway with focus on questions and answers. During Mission 3 NILU was focusing on practical exercises.

Mr. Rune Ødegård took care of the general training of AirQUIS applications, the use of the AQI generator and using AirQUIS for AQMS.

The actual work performed at DONRE using the AirQUIS system included and will also in the future include the emission inventorying, data retrieval, transfer of data into the databases, data treatment and presentation as well as dispersion and exposure modelling. The two workshops given during Mission 3 is described in Chapter 11.

7 Task 7. Air Quality Modelling

7.1 Prepare input data

As mentioned during earlier missions a number of data have to be collected to be able to run the dispersion models.

From the list of data required we summarised the status after Mission 3 as follows:

- Maps and GIS system have been prepared and is being operated in AirQUIS
- Emission data and emission inventories have started, all templates for collection of input data have been prepared with the DONRE staff
- Air Quality data is now being collected on an hourly basis and is being automatically transferred into the AirQUIS database,
- Meteorological data is the main headache at the moment. There might be adequate data for generating a dataset for modelling, but this will have to be verified.
- Population distribution data is not available yet and may only be needed for exposure estimates in the future.
- Area use and topographical data is part of the GIS database, but more detailed information about area use has to be collected and imported to the AirQUIS database.

7.2 Emission inventories

The emission inventory of point sources had started at DONRE based on templates received at NILU during the seminar in April 2003. Traffic emission data had not started and some of the data that could be collected by the DONRE experts was initiated as shown below.

DONRE was also requested to identify whether there were any dynamic traffic model for HCMC available.

7.2.1 Point sources

The first 34 point source owners and registers had been collected. The point sources related to emissions from single stacks and points. A total of 75 individual stacks have

been identified as of November 2003. This work started during Mission 2 and continued during the Seminar at NILU by presenting some of the templates used as input data to the AirQUIS emission inventory model. An example of the point source information collected so far is presented in Appendix G1.

All the templates for AirQUIS are available in Excel format, and the operating experts have been trained to use these templates directly. Some examples of the data collected for HCMC is presented in Appendix G1 and G2.

The sources are divided into groups according to the Corinair (snap) emission inventory system.

- Group 1 Combustion in energy and transformation industries
- Group 2 Non-industrial combustion plants
- Group 3 Combustion in manufacturing industry
- Group 4 Production processes
- Group 5 Extraction & distribution of fossil fuels and geothermal energy
- Group 6 Solvent and other product use
- Group 7 Road transport
- Group 8 Other mobile sources and machinery
- Group 9 Waste treatment and disposal
- Group 10 Agriculture
- Group 11 Other sources and sinks

7.2.2 Population distribution, area sources

Data for the population distribution given for each of the Districts in HCMC was collected during Mission 1. A more detailed population distribution should be collected if possible. No area sources have been evaluated yet, but it is foreseen that some of the traffic outside the main roads will be estimated as area sources.

7.2.3 Traffic and road emission data

Templates are available for collecting information on road links, vehicle classes, traffic densities etc. A simplified system for starting traffic density counting in HCMC by DONRE personnel was developed and presented as shown in Appendix G2.

It was suggested that some major streets and roads were selected first, that the road node positions were identified and imported to the templates. Further some main road links will have to be appointed and registered by start and end nodes, before counting can start. Some simple counts were undertaken as examples at 3 road links in District 3 of HCMC.

We also requested that before going into a complete data collection procedure DONRE should find out whether there are any dynamic traffic models available for HCMC.

The next issue will to establish emission factors for the different vehicle classes. This work was only briefly initiated. Final emission factors linked to the vehicle classes that were identified will have to e decided later in a co-operation between DONRE and NILU. Some examples of emission factors are presented in Appendix G3.

A first distribution of vehicle classes is presented in Appendix G4. NILU was also requested to present a simplified description of the sequence necessary to collect traffic emission data. This memo is presented as Appendix G5.

7.3 Dispersion modelling

The AirQUIS dispersion models include models for point sources, area sources and line sources. The main model is the EPISODE model recently described by Slørdal et al (2003).

Only short introductions to the models have been given so far to the DONRE experts. The extra support and training in model applications is included in the training support applied for at NORAD as part of the Reference Laboratory application.

A general workshop on modelling was prepared for the Mission, but as input data have not been available yet we postponed this presentation till next Mission. We also discussed the possibility of performing model training at NILU for one expert from DONRE.

8 Task 8. Field Operations

8.1 Start-up phase

All installations of the field instruments were installed in HCMC from 13 to 21 November 2002. As part of the start-up of monitor DOSTE field experts were trained to install and operate the monitors themselves. All parties have considered the start-up phase a success.

As part of the first phase a field study using passive samplers was undertaken in HCMC. A total of 40 passive samplers were located around the city from 14 to 24 November 2002 (Sivertsen, 2003).

8.2 Operational phase

Hand-on training in instrument maintenance, field calibrations and some simple repairs started during Mission 2. This training will, however, have to be continued and was part of the proposal presented to NORAD for the development of a Reference Laboratory at DONRE.

The data were retrieved in the beginning via hard disk cloning at the stations, which had not yet got e telephone line. Only at District 2 was there a line from the beginning. The last lines were installed in October 2003. All the data from the beginning of measurements were imported to the AirQUIS database during Mission 3.

A status of the monitoring programme as of November 2003 is presented in Appendix H1.

8.3 Audits of the stations

At monitoring systems designed and installed by NILU, a national reference laboratory normally undertakes regular audits to the stations.

After Mission 2 we have identified that several tasks will have to be undertaken to meet the requirements of a Reference Laboratory to be established at DONRE. We have recommended that a Reference laboratory is established in Vietnam, and that this

laboratory as a beginning could be established at DONRE, NORAD has received a request from DONRE for funding this development.

Audits to the monitoring stations from NILU experts will also be scheduled to take place during the HEIA project second year of operations. This will assure that operations are following the prescribed operational procedures, and that the monitoring system is operated according to international standards while NILU is undertaking the 3-year NORAD funded project.

8.4 Maintenance and service

The maintenance and service of all monitoring stations have been discussed in details both during Mission 1 and Mission 2. The DONRE field and instrument experts usually perform regular maintenance of the instruments at the station during routine service visits.

Mr Dam received financial support from the HEIA project to participate in an advanced training course held by API in California (level II). (See Appendix E1.)

Consumables for the 5 measurement stations were sent from Norway in October 2003. The list of consumables as specified by the instrument provider is presented in Appendix H2.

NILU also ordered 20 fuses for the OPSIS data logger, according request from DONRE. Data loggers have a tendency of breaking down during heavy storms. This happened during Mission 3. Data loggers should thus be part of the spare parts and specified in the spare part list.

NILU normally recommends a yearly overhaul where the instrument is examined, cleaned and adjusted more thoroughly. The overhaul will typically take about two days. This is also a task, which could be taken care of by a reference and maintenance laboratory.

8.5 Consumables and spare parts

The overhaul usually requires spare parts, consumables and tools that are easier accessible in the laboratory then at the station. Consumables and spare parts have been part of the deliveries and are being stored at the DONRE laboratory. A list of these consumables and spare parts was presented in Appendix H5 of Mission 2 report.

Very few spare parts have been taken out of this storage so far as seen in Appendix H3.

A new list of spare parts that are required for further operations is presented in Appendix H4. At the end of Mission 3 a list of high priority spare parts needed to keep the instrument operating was presented to NILU. This list is presented in Appendix H5.

8.6 Dynamic calibrations

The bi-annual (or annual as recommended by CEN and NILU) check and overhaul of instruments should be combined with a linearity check and performed at the same time in the laboratory. The linearity check requires a complete dilution/calibration unit.

As part of the maintenance and calibration procedures it would normally be necessary to establish a “reference laboratory” at DONRE. This would require a complete set of monitors as well as a multipoint calibrator with zero-air generator and standard gases. This was the basis for the application sent to NORAD on 25 November 2002.

9 Task 9. Data interpretations

9.1 Understanding AQ

Air quality and meteorological data collected by DONRE were imported to the AirQUIS database during Mission 3. The data were then used to generate the necessary statistics to present and explain the data.

Two workshops were organised to discuss the validity and the content of these data (See Chapter 11).

9.2 Meteorological data

The meteorological data collected at the 30 m tower at DOSTE have not all been correct since the measurements started. Lacking of training in the interpretation of data as well as malfunctions in the sensors or in the calibration factors has lead to a database that presently only can partly be used.

Several errors were identified in the meteorological data already during Mission 1. Mr. Seved Grytting of OPSIS AB who visited HCMC on 29-31 October 2002 also identified errors on the meteorological sensors. See Appendix H1.

The data have been commented in both Mission report 1 and 2. The data collected by the Gill sonic anemometer have never been entered into the database. These data experienced fatal errors already since October 2001.

Some meteorological data has been available between January and June 2003. These data were entered into AirQUIS for test and verification. The data quality from 1 January to 31 May 2003 has been discussed and presented in Appendix I1.

From these data it can be seen that there are no stability parameter, as the temperature measured at the lower level (at the shelter) has not been functioning at all. A stability parameter had to be generated using the turbulence indicator. Based on the Bulk Richardson number approach a stability parameter based on the vertical temperature gradient (delT) was generated based on measurements of solar radiation, temperature at one level, wind speed and relative humidity. The parameter is described in Appendix I2.

Interpretation of the data as well as some basic training in the understanding of wind, stability, turbulence and dispersion was presented in the workshop.
From the workshop presentations we were discussing wind roses for HCMC as measured at DOSTE during the period of available data.

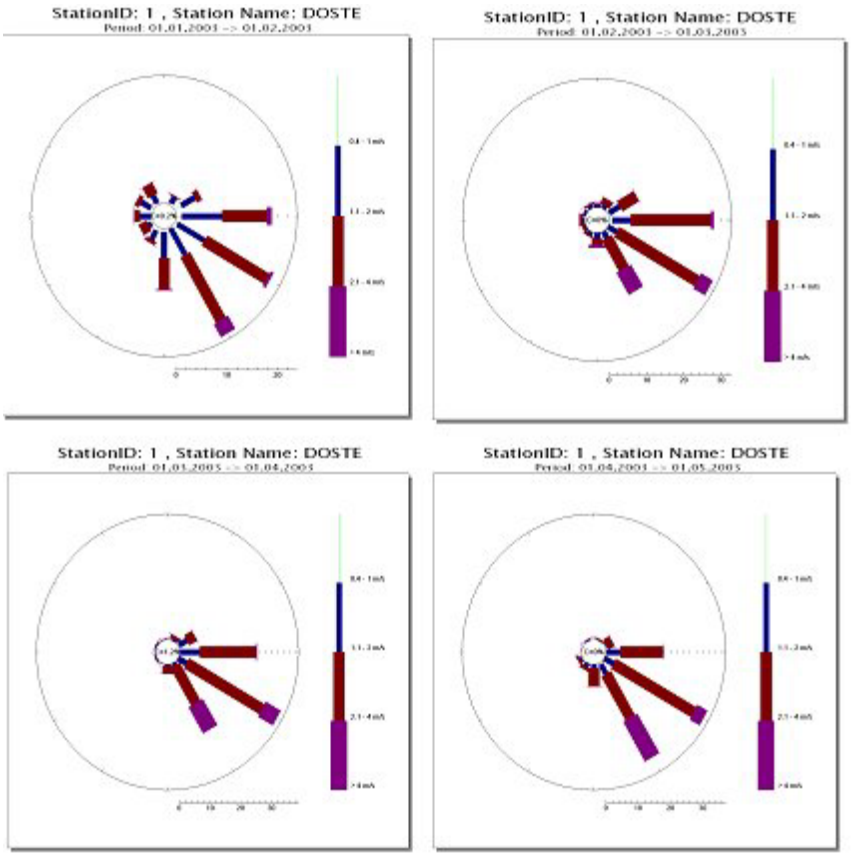

Figure 9-1: Monthly wind frequency distributions (wind roses) based on data from DOSTE from 1 January to 30 April 2003.

We see from Figure 9-1 that the wind was predominantly blowing from around east and southeast during the first four months of 2003.

9.3 Statistical evaluation

Both meteorological data and air quality were statistically evaluated during Mission 3 based on the AirQUIS system. The system offers several options for statistical and graphical presentations. Time series data can be presented and updated e.g. every hour included one or several indicators. Presentations can be prepared for screen presentations, for printouts or for automatic web presentations.

The Air Quality Index was updated and programmed into AirQUIS as presented in the next chapter.

9.4 Reporting Air Quality, the AQI

The **daily reporting** of air quality in HCMC is done through the generating of an air quality index (AQI). The AQI procedures were re-evaluated and some slight changes and improvements were included. The AQI procedures were then programmed into the AirQUIS system for automatic generation every day.

A detailed description of the procedures is presented in Appendix I3.

To assure that adequate data quality has been taken into account in the generation of the AQI, the following quality assurance has been considered:

- Data with *warning and exclude flags* will not be part of the AQI estimate.
- Negative concentrations are not included.
- At least 6 one-hour average concentrations are needed to produce a daily AQI

The final evaluation of the automatic AQI generator in AirQUIS will be undertaken in the near future, through testing and application. During the first runs we identified that stations with total missing data gave strange AQI values. Appendix I4 presents the AirQUIS screen dump for a case on 23 November 2003 when the automatic AQI generator gave strange results. By manually selecting only good quality data the AQI values were correct.
Verifications and testing will lead to a final version to be issued during the next few months

The **monthly reporting** procedures will be updated to include all 9 monitoring stations. The monthly reports will also be upgraded to include some more statistics based on the AirQUIS system. Combinations of air quality data with meteorological data will be presented in the future. Also frequency distributions and percentages of exceeding national standards should be included.

The generation of an **annual report** has also been discussed. During Mission 3 there was no time to go into these procedures, but the matter has been put on the agenda for the next Mission.

9.5 Internet presentations

NILU has been preparing web applications for air quality data presentations for several projects. During the visit of DOSTE experts to NILU in April 2003 NILU presented various web applications and discussed future possibilities with DOSTE.

NILU can deliver different web solutions depending on the needs and requirements of DOSTE. There are several ways of showing information on the Internet. There are also many ways of using the Internet both for presenting general information, projects and

results, as well as dissemination of online environmental data retrieved directly from monitoring networks.

During Mission 3 a web application for the direct daily presentation if the Air Quality Index had been prepared. NILU is delivering Internet solutions linked to the AirQUIS monitoring and modelling platform utilising the automatic data retrieval system (ADACS).
See: www.nilu.no and
http://www.luftkvalitet.info/

10 Task 10. Air Quality Assessment

10.1 Use of AirQUIS

Air Quality Assessment using the AirQUIS system has already been part of the training both at NILU and during Mission 3. Data statistics and interpretations have been discussed in the workshops. Some figures used in the workshop are presented in Appendix J.

It is our feeling that the understanding of air pollution through the chain; emissions-dispersion-meteorology-air quality - impacts, will have to be trained through actual operations. Only hand-on training will finally support the local experts to interpret and understand the air quality.

This will therefore be the issue for future co-operation, and a main issue during the next Mission.

DONRE experts are also being trained to use the system for air quality management. The first introduction and training was undertaken during the seminar at NILU in March-April 2003. Also after the installation of AirQUIS in HCMC some hand-on training in the application of AirQUIS for preparing the relevant input data to the models was offered.

More detailed training in running the models has been postponed due to the fact that the DONRE experts have their hand full with operating the monitoring system and thus assure quality in the air pollution data and meteorological data that goes into the planning models. We have also started the collection of emission data, which is essential for the models.

It has been assumed that model applications will be part of the next Mission. We also discussed the possibility of bringing one expert from DONRE to NILU for a few weeks for training together with NILU model experts.

10.2 Emission inventories

As indicated before the collection of raw data for the emission inventory models have started. Data already collected from the industries are stored in the computer at the computer centre at DONRE. These data, when complete, will be imported to AirQUIS through the templates that they have used during the collection of input information.

For modelling and planning purposes it will be important to achieve a complete emission inventory as possible.

10.3 Model exposure estimates

The dispersion models ("EPISODE") (Slørdal et al. 2003) available in AirQUIS will enable quantification of changes in exposure and population responses to changes in source composition and emissions, which in turn is necessary for an evaluation of impacts of e.g. road traffic system changes on urban scale.

The modelling system at NILU is constantly being revised and improved, and we believe that the version prepared for HCMC has presently been the best available.

Another important input parameter is the meteorological data, which we have not yet prepared. As discussed in previous chapters we may have to generate a set of standard meteorological dataset to be used for modelling purpose. This is also normally the procedure for other urban areas. However, we still have not seen a good data set for this purpose.

10.4 Abatement and planning

The use of AirQUIS for abatement strategy planning will be part of the capacity building and training programme. Emission reduction scenarios, a plan for action and measures to improve the air quality in HCMC has to be developed by local experts in co-operation with Norwegian experts.

11 Task 11. Capacity building

Capacity building and training has been an important part of the NORAD financed HEIA project. Still we see clearly that the training component should have been more extensive, as pointed out from the very beginning of the project-planning phase.

Training needs have been identified both for operations and maintenance of instruments, for data retrieval and controls as well as for understanding air pollution and performing air quality assessment and planning.

11.1 Kick-off seminar

The kick-off seminar was prepared and held at DONRE during Mission 1 and was reported in Mission 1 report and in a separate presentation of the seminar slides has been prepared as a NILU document (Sivertsen, 2002)

11.2 Instruments and monitors

A large part of the tasks undertaken by Rolf Dreiem during and after the installations in November 2002 was connected to the handling and operation of instruments.

Further training was offered to Mr Dam by API and financed partly by the HEIA project in August 2003. (see below). Further training has also been a key issue in the development of a Reference Laboratory at DONRE. (See Chapter 8)

11.3 Data retrieval and QA/QC

Mr. Vo Thanh Dam, who has been appointed responsible for quality assurance at DONRE, was supported by the project to undertake advanced training at API in California. Teledyne -API company organised a training class for better understanding the API instrument maintenance and repair (level II). (See Appendix E)

Hand-on training in the use of the AirQUIS system for daily quality check of data has been undertaken. These quality controls will also be part of the routine operations and further training may be needed when more experience in data understanding has been reached.

11.4 AirQUIS training

A seminar and workshops were held at NILU in March-April 2003 to train 3 selected experts from DONRE in using the AirQUIS system. The following experts participated from DONRE:

- Le Van Khoa,
- Vo Thanh Dam;
- Tran Thanh,

The training programme is presented in Appendix K1, and a comprehensive report from the seminars is presented by Laupsa and Johnsrud (2003).

AirQUIS training continued during the installations at DONRE as part of Mission 3. The main part of this training concentrated on data retrieval/import and evaluation of measurement data. The modules for emission inventories were briefly discussed, while the modelling modules will be part of the training before and/or during the next Mission.

11.5 Use of models

As mentioned above we are not yet ready to start air pollution dispersion modelling using AirQUIS. Air quality data statistics including the use of meteorological data in air quality interpretation and presentation will have to be prepared.

The DONRE staffs is also working on preparing the emission input data. Procedures for air quality impact assessments as well as preparation of abatement options and scenarios have to be presented later.

11.6 Statistics and reporting

During the training to be performed at NILU and at DONRE during Mission 3 in November DONRE experts have received both hand-on training and class-room training in the application of AirQUIS for statistics and reporting purposes.

11.7 AQ assessment and planning

The air quality assessment work, which will be performed at the end of the project, briefly started during the workshops at NILU in April 2003. The input data for this assessment will be prepared together with NILU experts in HCMC.

11.8 Abatement strategies

The abatement strategy planning will be a continuation of the assessment work. For optimal abatement strategies data on abatement costs as well as cost estimates for air quality impacts will have to be estimated. This is the last phase of the 3-year project.

Methods and procedures for continuing the modelling work into strategy planning will have to be prepared during the first half year 2004.

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Appendix A

Task 1. Review existing system and preparations

Appendix A1: Daily schedules

Mission 3, November 2003

Day	Hr.	Assignment	NILU	DONRE	Done
2 Nov		• RuO and TNT arrive in HCMC	RuO, TNT		OK
3 Nov		• Start up meeting • Establishment of HW, SW and Network at DOSTE	TNT, RuO TNT	LVK, VTD, TrNT, LSQT, NBQ, NTH VTD, TrNT	OK
4 Nov		• Configuration and testing of Automatic Import of measurement data from 9 DOSTE stations	RuO, TNT	VTD, TrNT, NBQ, NTH	OK
5 Nov		• Configuration and testing of AQI and GIS	RuO, TNT	LVK, VTD, TrNT, LSQT	OK
6 Nov		• Training of AirQUIS 2003 – Administration, Measurement and GIS using DOSTE data • BS arrives in HCMC	RuO, TNT	VTD, TrNT, LSQT, NTH	OK
7 Nov		• Training of AirQUIS 2003 – Emission Inventory – Point Sources using DOSTE data • Verification of existing data	RuO, TNT BS	VTD, TrNT, LSQT	OK
Monday 10 Nov	0900 1800	• Training of AirQUIS 2003 – DOSTE data • Meteorological data evaluation • AQI index programming • Dinner at Mme Toi	RuO, TNT BS RUO	LVK, VTD, TrNT, LSQT	OK
11 Nov	0900 1100	• Training of AirQUIS 2003 • Finalizing AQI • Air Quality data evaluation	TNT RuO BS	LVK, VTD, TrNT, LSQT	OK
12 Nov		• Air Quality in AirQUIS • AQI graphs for presentation • AirQUIS implementation • AirQUIS emission data • Point source input data	TNT, BS RuO TNT BS, TNT BS, RuO	LVK, VTD, TrNT, LSQT LVK, VTD VTD	OK
13 Nov		• Point source data • AirQUIS training applications • Model input data to AirQUIS • Training in system maintenance	RuO TNT RuO, BS TNT	LVK, VTD, TrNT, LSQT VTD, TrNT VTD	OK
14 Nov		• Import manual data to AirQUIS • Inventory of spare parts and consumables for the 5 new measurement stations • Training in system maintenance • AQ statistics from AirQUIS	RuO TNT BS TNT RuO, BS	VTD, LSQT staff VTD, TrNT	OK

Day	Hr.	Assignment	NILU	DONRE	Done
15 Nov	1000	• AirQUIS training, summary • Final corrections, installations • Data testing, discussions • RuO and TNT leaves HCMC	RuO,TNT BS, RuO	Staff DONRE	OK
Monday 17 Nov	0900	• Prepare Air Quality presentations using AirQUIS	BS	VTD	OK
18 Nov	0900 1500	• Prepare workshop • Discuss further projects	BS BS	 LVK, VTD,	OK
19 Nov	1100 1500	• Data analyses, emission data • Status monitoring sites, spare part requests	BS	VTD, TrNT, NBQ, NTH	OK
20 Nov	0900 1100 1500	• Prepare workshop (internal) • Met data evaluation • Workshop starts, met data	BS	 LVK, VTD, TrNT, LSQT	OK
21 Nov	0900 1130	• Summary and discussions from workshop • Half day off	BS	VTD, LVK	OK
Monday 24 Nov	0900	• Reporting • Air Quality data evaluation	BS BS		OK
25 Nov	0900 1500	• Discuss future co-operation, • Develop plans for 2004 • Project on National AQ system?	BS BS	LVK, VTD	OK
26 Nov	0900 2000	• Summary of Mission 3 • BS leave HCMC	BS	LVK, VTD, TrNT, LSQT	 OK

The staff

DOSTE	
Doan Thi Toi (DTT),	Head of Environmental Management Division
Nguyen Thi Tuyet Hoa (NTTH),	PIU Secretary
Le Van Khoa (LVK),	Project Manager DOSTE
Le Sanh Quoc Than (LSQT)	Instruments expert, field operations
Vo Thanh Dam (VTD),	EDC, data retrieval, reporting, field
Tran Ngoc Thanh (TrNT),	EDC, computers, index reporting
Nguyen Bao Quoc (NBQ),	Instrument expert, field operations
Nguyen Thanh Huy (NTH)	Instrument expert, field operations
NILU	
Bjarne Sivertsen (BS)	Project Manager
The Nguyen Thanh (TNT)	IT Manager, Computer expert
Rune Oedegaard (RUO)	AirQUIS expert
Rolf Dreiem	Instrument expert

Appendix A2: Minutes from project meeting no. 6

Department of Science,
Technology and Environment (DOSTE)
The Norwegian Institute for Air Research (NILU)

Minutes

Title:	**Project meeting no. 6**
Date	25 February 2003
Participants:	Bjarne Sivertsen (BS), The Nguyen Thanh, (TNT), Herdis Laupsa (HEL)), Rolf Dreiem (RD)
Prepared by:	B Sivertsen
Distribution:	Participants, Leif Marsteen (LM), Finn Bjørklid (FIB) Steinar Larssen, Mona Johnsrud (MJ), Le Van Khoa, DOSTE, OEH, PB

1. Agenda

1. Project status just now, report from evaluation (SFT/NILU)
2. Status instruments and field operations
3. Data retrieval and AirQUIS interfaces.
4. AQ and met data from HCMC, data import to AirQUIS
5. Status AirQUIS, platform, GIS, maps
6. Prepare seminar (see programme), who do what?
7. Air QUIS installation preparations (who?)
8. Other matters

2. Summary of meeting

2.1 Project status just now, report from evaluation (SFT/NILU)

SFT representatives evaluated the HEIA project in a meting at NILU on 20 February 2003. The organization and sustainability of the project was specifically discussed. We pointed out that the sustainability pf the project would be dependent on managing to establish a calibration and reference laboratory at DOSTE. This has been estimated at a cost of about 850.000,- NOK. A letter has been sent to NORAD signed by the Director of DOSTE to request supply for this laboratory.

The organization of the project is well handled, and installations of all the field equipment was undertaken on schedule in November 2002. However, it was again stressed that the training component is very limited, and that more training has to be added to the project for the DOSTE expert to manage the system in the long run. This together with quality assurance, modelling and air quality planning would add another needed 1,1 million NOK to the project. The SFT representatives; Tor Færden and Maren Vikheim indicated that they would request a total additional need of about 2 million NOK to meet the required additional input.

The DOSTE representative Mr Khoa will during his visit to NILU also pay a visit to SFT on Tuesday 8 April 2003 from 10:00 hrs.

2.2 Status instruments and field operations

Some comments and questions from DOSTE concerning the operation of instruments in HCMC have been answered. Details can be seen in Appendix A.

Generally there has been very little errors or malfunctions on the equipment so far.

Filter holders for pre-filters to be installed at the air intake to all monitors will be purchased and delivered to DOSTE experts when they visit NILU in March-April. New door locks to the shelters will also be provided to DOSTE at their visit to NILU.

Spare parts will be sent from Norway on 10 March 2003. The shipment will be finally confirmed.

2.3 Data retrieval and AirQUIS interfaces.

Two telephone lines have been installed and are being operated. TNT has been tested the connections, but has not managed to retrieve data directly to NILU yet. Another attempt will be made on 26 February.

Interfaces between the Enviman database and the AirQUIS system will be prepared. TNT will present this during the seminar.

2.4 Data import to AirQUIS

Data have been received in Excel format one site, TN: Thong Nhat Hospital. These data will be imported to AirQUIS as a basis for tests and training. No meteorological data have been seen yet. BS checks with DOSTE the status on meteorological data retrievals.

NILU will request DOSTE to prepare data according to a format specified during Mission 1 (page 87 of Mission 1 report) and repeated during Mission 2. DOSTE has asked to present one site all compounds. NILU has accepted this and is modifying the input files for AirQUIS to match these specifications.

2.5 Status AirQUIS, platform, GIS, maps

We have still not received the digital maps requested in December 2002. TNT will check the status. Maps will have to be imported in AirQUIS during the first weeks of March.

It has been decided that the server for AirQUIS will be purchased in Norway. AirQUIS will be installed and presented to the DOSTE experts during the seminar in April. The

ready installed and tested AirQUIS for HCMC will then be shipped to HCMC when the NILU team arrives for final installations and training in HCMC.
One client PC will have to be purchased locally in HCMC according to specifications given by TNT in Mission 2 report.

2.6 Prepare seminar

The seminar programme has been prepared and sent DOSTE. (The programme was presented in an Appendix B to the minutes. The final seminar programme can be found later.)

The programme was discussed in details, and tasks and obligations distributed. HEL will update a more detailed list of seminar programmes. HEL will also discuss details in the presentations with MJ.

2.7 Air QUIS installation and preparations

TNT will purchase the server for the HEIA project as soon as possible. TNT will also be responsible for the necessary installations of AirQUIS and databases. HEL is responsible for preparing adequate data before the seminar starts.

During the seminar the server and 3 clients will be prepared in meeting room UB. All necessary rooms as well as accommodations for 3 experts from DOSTE have been taken care of (BS/SBH).

Necessary material, papers, reports and documentation will be discussed further on 20 March 2003.

2.8 Other matters

Instrument request from DOSTE

Request from DOSTE 11 February 2003

1.I've already checked the spare parts and consumables list, it's look perfect.
I just want to add 1 thing to the list is: UV filter 360 NM (for API M100A) and how about spare parts for DL256, UPS and Air conditioner.

2.We need 2 AGA gas cylinder regulators: 1 DIN8 and 1 DIN5 (we still have five regulators but they are DIN1) and pre-filters for our API instruments.

3.We have some problems when we use the cylinder to zero and span check for instruments. The gas conc. input of the cylinder is 1040 ppb NO but the instrument only read around 759 ppb although we wait for more than 30 minutes (please see the attachment file for example). Please explain this problem clearly!!

Answer from Rolf Dreiem 21 February 2003

Sorry for late answer but I had to do some checking on API NOx first.

1. First I can tell you that spare parts will be sent to you within one week.
The box will also contain one DIN5 and one DIN8 to your regulators. (And one UV-filter.)

2. Second is the problem with PM10.
Check connection on DL256:
Yellow wire on C1/1 (+)
Green wire on C1/2 (-) This is dust concentration.
Red wire on C1/3 (+)
Blue wire on c1/4 (-) This is total mass.
When this is connected to instrument and data logger you can measure 1 and 2 and 3 and 4.

The multi meter should read from 2 to 10 VDC. 2V at zero (new filter and 10 V at maximum, 1500 microgram/m3.
Eberline is the only analogue instrument; remember that the SETUP on data logger is different from API instruments.

3. Spare parts for DL256: We have none. If one brakes down you ask for the broken part or get a new data logger from Opsis.

4. UPS and Air Conditioner you have to repair locally.

5. GAS CYLINDERS and REGULATORS
The supplier in Norway said yesterday that you have got all gas cylinders:
3 pc 50 l 1 ppm SO2.
2 pc 50 l 50 ppm CO.
5 pc 50 l 1 ppm NO.
1 pc 10 l 50 ppm CO.
1 pc 10 l 1 ppm SO2.
1 pc 10 l 1ppm NO.
All with regulators. Please confirm this.

6. Pre-filters.
From the spare part and consumables list I can see that you have 700 filters. If you change on all API monitors every week this will last for 1 year. You will have another box of consumables before one year of operation.

7. NOx-monitor

Are you sure that the Y-connector is correct fitted:
One end to NOx monitor.
One end to gas cylinder.
One end to lower end of flow meter.
Top end of flow meter is free.
Adjust gas flow to .6-.7 on flow meter.
There is no zero air cylinders in the shelters. Only Zero Air Generators.
Connect zero air the same way as gas cylinder.

Run zero and span on the instrument as a test without pushing any buttons on the instrument. If you have another results, please read SOP very carefully once more.
Make sure the certificate is the correct one. Compare cylinder number on certificate and on the cylinder.

Even if cylinder certificate is OK it might be another concentration on the cylinder.

Please bring the cylinder to another station where NOx monitor is working and do a test on this cylinder.

Next you can read sample flow on the display (500 cc) and take the tube out of the glass manifold. Put your finger on the end of the tube and block it.
The flow is no going to 0. If not you have a leak.

I can see from your Calibration sheet that slope is changed from close to 1.000 in late Nov. to 1.384 29. Jan 2003.
It is very unusual to have a so big drop in sensitivity in just 2 months.
Have the instrument been running without filter???

For further investigation you must fill inn table 2.1 and return the table to me.
I also need a copy of station log and instrument log from the day we started the station in November.
All information is helpful in solving the problem.

Appendix A3: Minutes from project meeting no. 7

Department of Science,
Technology and Environment (DOSTE)
The Norwegian Institute for Air Research (NILU)

Minutes

Title:	**Project meeting no. 7**
Date	25 February 2003
Participants:	Bjarne Sivertsen (BS), The Nguyen Thanh, (TNT), Rolf Dreiem (RD),
Prepared by:	B Sivertsen
Distribution:	Participants, Rune Odegaard (RuO), Leif Marsteen (LM), Steinar Larssen (STL), Karl Idar Gjerstad (KIG), Paal Berg (PB) DOSTE (Le Van Khoa, Mr. Dam), SFT (Færden, Wikheim), NORAD Hanoi

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1. Agenda

1. Project status just now
2. Status instruments and field operations, any news?
3. Data retrieval and AirQUIS interfaces.
4. AQ and met data from HCMC, data import to AirQUIS
5. Status AirQUIS, platform, GIS, maps
6. Prepare visit to HCMC in November,
7. Air QUIS installation preparations and training (who, what, when?)
8. New reference lab? News from NORAD?
9. Other matters

2. Summary of meeting

2.1 Project status just now

The project is progressing well and according to schedule.
Mr. Dam has been participating in the API training course in California, paid by the HEIA project. The attendance has been a very good opportunity for me, Mr Dam told us. I have learned how they solve the problem, having a total looking of their lab system. This was a level II course, which focused on troubleshooting and maintenance. It has provided good insight in advanced operation and maintenance of the instruments in the future.

DOSTE is planning to move to new offices during 2003. This moving will not influence on the next visit by NILU experts to HCMC, and the installation of AirQUIS at DOSTE.

2.2 Status instruments and field operations

All monitoring sites are at present being operated with data retrieval via telephone lines. There has been no reporting of malfunctions or problems with monitors, samplers or any of the equipment during the last 3 months.

The problems related to the NOx monitors was tried to be solved via mail already in February. During the visit of DOSTE experts to NILU in April 2003, there were still problems with the calibrations. The problem was analysed and final solutions were presented to DOSTE

Rolf Dreiem stated on 15 May:

> The problem with NOx analyzers was very difficult to understand. I have never seen that 5 analyzers are loosing sensitivity so quickly. After looking at all data you sent to NILU I found that the instruments is working well and nothing is wrong. Calibration cylinders are also within specification.
> Here at NILU we are running all new instruments for many weeks in the calibration laboratory before a calibration is done. Your instruments had just been working for a few days before calibration was done. NOx analyzers lose sensitivity during the first weeks after the release from the factory.
> My advise to DOSTE is:
> 1: Keep all analyzers as they are as long as the slope is within limits (below 1.3) when calibrated with NO cylinders.
> 2: If slope is above 1.3 adjust optic test to specifications.
> PMT 2000 and NO-NOx 1000. Described in the manual page 9-23, chapter 9.1.6
> If the slope goes a little above 1.3 you do not have to rush on doing a factory calibration. I would say that up to 1.4 is OK. If the slope goes too high (or low) the calibration curve is un linear and the measurements will be wrong.

NILU will ask DOSTE for a short statement on the status of the air quality data collection. Are all sites and instruments working properly? Please give us a brief status for each of the instruments located in the different shelters.

2.3 Data retrieval and AirQUIS interfaces.

The data retrieval system seems to work. All stations have telephone communication lines. The OPSIS data logger is, however, not working properly. Using the function “data presentation” at the shelters generates an error. This error cannot be repaired by DOSTE. OPSIS will have to be contacted to look into the problem when they are visiting the region for other purposes. The error is not crucial for transferring data to the database.

2.4 AQ and met data from HCMC, data import to AirQUIS

Templates have been given to DOSTE during the Seminar at NILU in April. Emission data from a total of 46 point sources have been collected, while area sources and line sources will have to be postponed till after the next Mission by NILU experts to HCMC.

DOSTE has prepared the data according to the format specified in the Templates. The data should be sent by Mail to NILU, so that this information can be installed in AirQUIS as part of the preparation before the installation in HCMC.

NILU would also like to evaluate the meteorological data from the DOSTE site. Is the meteorological station working? Are there data available? Can we receive a sample of these data?

2.5 Status AirQUIS, platform, GIS, maps

The AirQUIS version that was installed on a DOSTE PC during the Seminar at NILU in April is not presently working. Mr. Dam has requested an additional version before the next NILU Mission.

The new server, which will be used for the final AirQUIS version to be installed at DOSTE in November 2003, is already at NILU. AirQUIS has been installed, and GIS and data will be prepared before the next Mission. TNT will install and RuO will perform training of local experts at DOSTE. The server should be sent to HCMC at least two weeks prior to the Mission.

2.6 Prepare visit to HCMC in November

The next Mission to HCMC was originally planned from first week of November. After a discussion of data availability and team obligations, NILU and DOSTE concluded that the best suitable period for the whole team to start the next Mission would be on **16 November 2003**. At this time all installations will have been completed, the server will have arrived in HCMC and the DOSTE team have collected as much data as possible (emissions, meteorology and air quality). We also may know more about the possibilities for establishing the reference laboratory at DOSTE. (See below).

The team will consist of Bjarne Sivertsen (team leader), The Nguyen Thanh (IT expert), Rune Odegaard (AirQUIS expert). Mr. Rolf Dreiem may be added to the team if support from NORAD concerning the establishment of a Reference Laboratory s has been indicated.

2.7 Air QUIS installation preparations and training

TNT has already purchased the server for the HEIA project. TNT will also be responsible for the necessary installations of AirQUIS and databases. Due to illness from key personnel at NILU, the ADACS (Automatic data communication system) has not been finalised. This work is now in progress again.

The Air Quality Index (AQI) procedures and routines are being programmed, and will be finalised in time before the final installations (RuO/ KIG).

RuO (AirQUIS training) and BS (general AQMS, using meteorological data and modelling) will prepare the necessary training programmes to be presented in HCMC in November.

2.8 New reference laboratory and further training at DOSTE.

In a mail from Nguyen Thi Tuyet Hoa on 13 August 2003 it was stated that "The Royal Norwegian Embassy in Hanoi, Vietnam had requested DOSTE to send them one official letter for additional funds related to a calibration laboratory and additional training."

The necessary documentation and a project proposal developed for the Norwegian Pollution Control Authority and forwarded to Tor Færden and Maren Wikheim on 11 April 2003, was provided to DOSTE. In the conclusions of this document it was stated:

To improve the institutional capacity at DOSTE the following additional tasks should be added to the original project proposal:

- *One extra workshop and one seminar*
- *Additional training for monitoring operations and QA/QC*
- *Training for operation of the Reference Laboratory including multipoint calibration*
- *Training for maintenance and repair*
- *Improving the modelling capacity*
- *Input data evaluations and control A*
- *Additional support for maintaining local network/ Backup solutions*
- *Correct meteorological errors and perform training in Meteorology*

The total cost for these tasks included the necessary instruments to establish a Reference and Calibration Laboratory at DOSTE has been estimated to

1 688 316 NOK

We will ask DOSTE to request again from NORAD what has happened to the application. A positive response from NORAD will give DOSTE more and improved training and will initiate the planning of the of the reference laboratory establishment.

Appendix A4: Letter from DOSTE reconfirming the need for a reference laboratory

Department of Science, Technology and Environment
244 Dien Bien Phu Street, District 3
Ho Chi Minh City, Vietnam
Phone: 84-8-9326299/9326709
Fax: 84-8-9325711/9326299
Email: piuvie1702@hcm.vnn.vn

NORAD
Royal Norwegian Embassy
Metropole Centre
Suite 701/702
56 Ly Thai To
Hanoi, Vietnam

Att: Ragna Fidjestøl,

Ho Chi Minh City, August 12, 2003

Ho Chi Minh City, Air Quality Monitoring Project

With reference to the telephone conversation with Mr. Chinh from the Royal Norwegian Embassy - Hanoi this week and the proposal from NILU of 09 April 2003 including our letter of 25 November 2002, we are confirming that the need for establishing a Reference Laboratory is a very important part for completing the ongoing project "the Ho Chi Minh City Environmental Improvement Air (HEIA)" funded by NORAD. During the implementation of this project a lot of expert know-how knowledge regarding air quality monitoring, management and planning has been transferred from the NILU experts to the DOSTE Team. We have a very good co-operation with NILU and we have great faith in this project.

We would very much like to complete this project by implementing the Reference Laboratory at DOSTE. With the Reference Laboratory functionality DOSTE will have the necessary equipment and competence to sustain and further develop the air quality management programme by our selves.

We are looking forward to a positive response from NORAD regarding the extra funding for the Reference Laboratory. The funding amount we are asking for is **1 688 316 NOK**. For more details, please see the attachment "Improving the sustainability of the HEIA project – Training needs assessment and quality assurance"

Yours sincerely

Prf. Dr. Dao Van Luong
Director of DOSTE

Appendix B

Task 2. Design and update

Appendix B1: New sites

New sites

Location of NILU/NORAD sites in HCMC

The 5 shelters were moved to the sites on 12 and 13 November 2002. A new list of sites with instrumentation and shelter number specifications is presented below.

The final sites for air quality measurements prepared by NILU in HCMC.

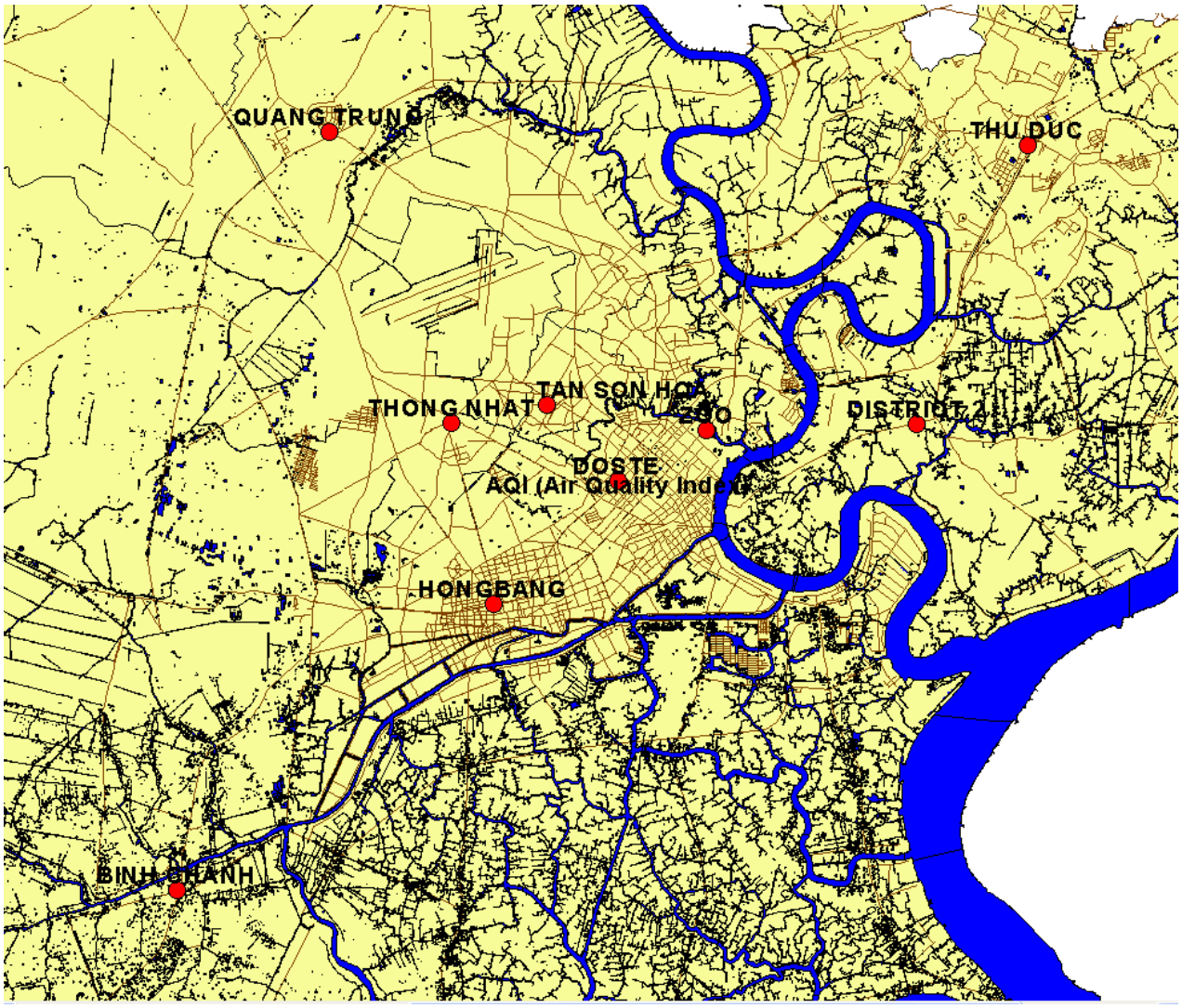
Site	NO_x	SO_2	O_3	CO	PM_{10}	VOC	Shelter no	Site
5. District 1- Zoo	1		1		1		839	Urban background.
6. Quang Trung- Software City	1	1	1		1		838	Residential urban background
7. District 2 PC	1	1	1		1		837	Residential .
8. Thong Nhat hospital	1	1		1	1	1	840	Road side
9. Binh Chanh Educat. Centre	1			1	1	1	841	Road side
Total instruments	5	3	3	2	5	2		

Air Quality Measurement Sites in HCMC, UTM positions

The final set-up of measurement sites in HCMC is shown below. The positions given in UTM co-ordinates as well as on the map available in AirQUIS is also presented below.

Station			UTM 84 N	
ID	Code	Name	X coordinate (m)	Y coordinate (m)
1	DO	DOSTE	684,430	1,192,220
2	TS	Tan Son Hoa	682,830	1,193,930
3	TD	Thu duc	693,640	1,199,790
4	HB	Hong Bang	681,620	1,189,460
7	ZO	Zoo	686,420	1,193,370
9	QT	Quang Trung	677,940	1,200,080
8	D2	District 2	691,160	1,193,510
5	TN	Thong Nhat	680,690	1,193,530
6	BC	Binh Chanh	674,500	1,183,000

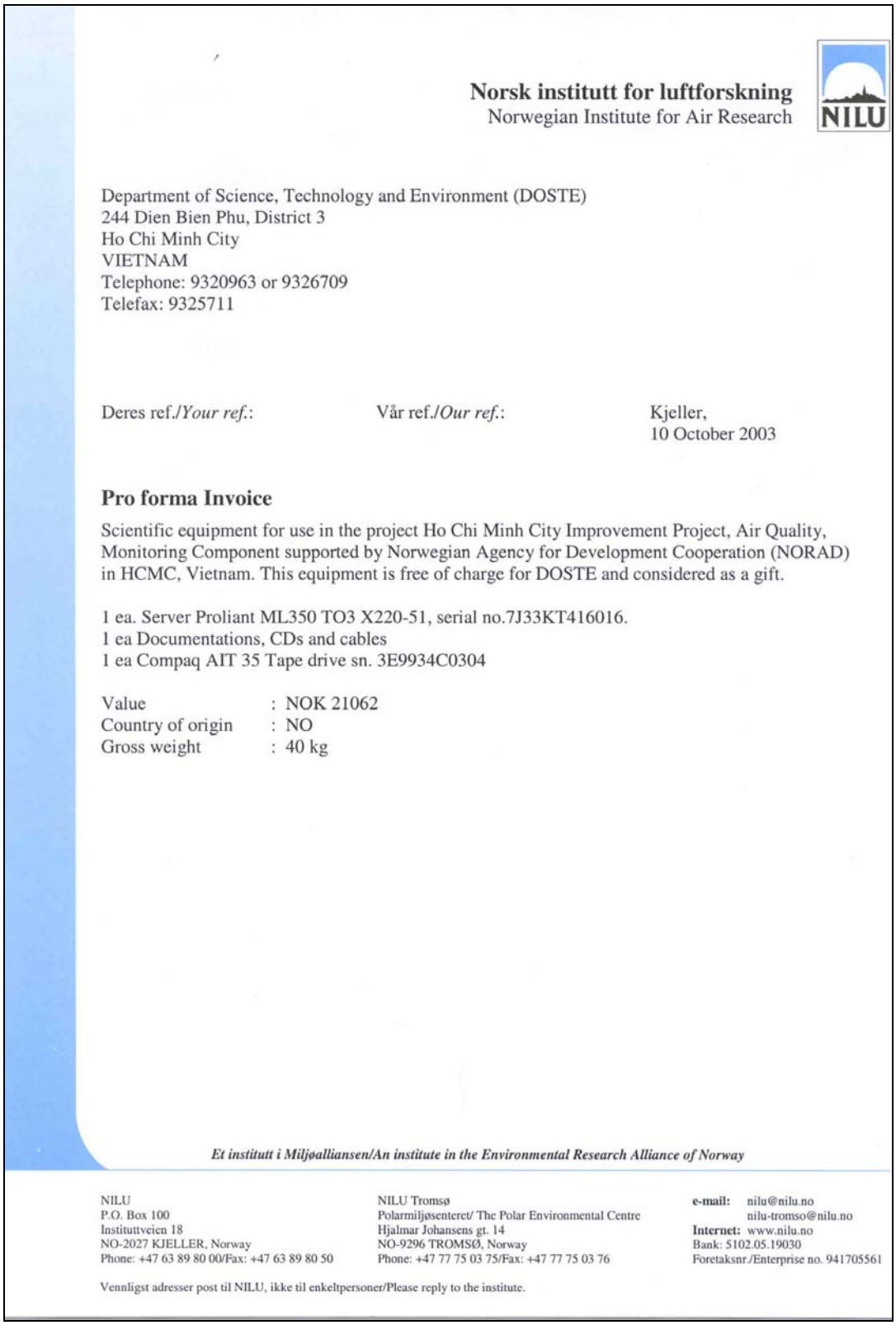
The station ID is according to the database ID as found in the AirQUIS database.


QUANG TRUNG
THU DUC
THONG NHAT
TAN SON HOA
DISTRICT 2
DOSTE
AQI (Air Quality Index)
HONGBANG
BINH CHANH

Appendix C

Task 3. Procure and install

Appendix C1: Pro forma Invoice



Norsk institutt for luftforskning
Norwegian Institute for Air Research

NILU

Department of Science, Technology and Environment (DOSTE)
244 Dien Bien Phu, District 3
Ho Chi Minh City
VIETNAM
Telephone: 9320963 or 9326709
Telefax: 9325711

Deres ref./*Your ref.*: Vår ref./*Our ref.*: Kjeller,
10 October 2003

Pro forma Invoice

Scientific equipment for use in the project Ho Chi Minh City Improvement Project, Air Quality, Monitoring Component supported by Norwegian Agency for Development Cooperation (NORAD) in HCMC, Vietnam. This equipment is free of charge for DOSTE and considered as a gift.

1 ea. Server Proliant ML350 TO3 X220-51, serial no.7J33KT416016.
1 ea Documentations, CDs and cables
1 ea Compaq AIT 35 Tape drive sn. 3E9934C0304

Value : NOK 21062
Country of origin : NO
Gross weight : 40 kg

Et institutt i Miljøalliansen/An institute in the Environmental Research Alliance of Norway

NILU
P.O. Box 100
Instituttveien 18
NO-2027 KJELLER, Norway
Phone: +47 63 89 80 00/Fax: +47 63 89 80 50

NILU Tromsø
Polarmiljøsenteret/ The Polar Environmental Centre
Hjalmar Johansens gt. 14
NO-9296 TROMSØ, Norway
Phone: +47 77 75 03 75/Fax: +47 77 75 03 76

e-mail: nilu@nilu.no
nilu-tromso@nilu.no
Internet: www.nilu.no
Bank: 5102.05.19030
Foretaksnr./Enterprise no. 941705561

Vennligst adresser post til NILU, ikke til enkeltpersoner/Please reply to the institute.

Appendix C2: Equipment cost

Memo

Title	Equipment cost
Purpose	Present summary of all equipment costs based on invoices sent to DONRE as of November 2003
Distribution	Le Van Khoa (LVK), Vo Thanh Dam (VTD) and The Nguyen Thanh (TNT)
Author	Bjarne Sivertsen
Date	13 November 2003
Reference No	O-101143

NILU was requested to give an overview of the total value of all equipment sent to DONRE since the beginning of the HEIA project. The estimate presented below is based on the invoices received at DONRE. The invoice data is given in the table.

Total cost of Equipment

Date	Item	Sent from		Price
				(NOK)
30.09.2002	Monitors, shelters etc.	NILU		2825790
18.12.2002	Gases SO2	NILU		40700
	Gases CO	NILU		13650
	Gases NO	NILU		50600
01.01.2002	Data loggers	OPSIS		20000
04.04.2003	Spareparts	IM		155520
10.10.2003	Server AirQUIS	NILU		21062
13.10.2003	Computers, scientific eq.	NILU		66900
	Total costs of equipment			3194222

Total value og equipment in US$	**456317**

The total value of equipment was estimated at 3,194 million NOK or 4, 563 US $.

Appendix C3: Delivery List

Norwegian Institute for Air Research, NILU
P.O. Box 100, N-2027 Kjeller
Norway
Office: Instituttveien 18

Delivery list

Project	HCMC Mission 3 - Installing of AirQUIS 2003
Project No	O-101143
Customer	DONRE
Delivery Date	15 November 2003

No of Items	Item Description	Status
CD		
1	AirQUIS 2003 Application version 2.0.330	Delivered
1	AirQUIS 2003 Templates	Delivered
1	AirQUIS 2003 Documentation	Delivered
1	Windows 2000 Server	Delivered
1	Veritas Backup Exec	Delivered
3	Oracle 9.2 (copy)	Delivered
Documentation		
1	Windows 2000 Server Licence stick	Delivered
1	Veritas Backup Exec Software License Certificate	Delivered
1	Oracle 9.2 server and client installation	Delivered
1	AirQUIS User documentation – Admin and Main Module (Draft)	Delivered
1	AirQUIS User documentation – Geographical Module (Draft)	Delivered
1	AirQUIS User documentation – Measurement Module (Draft)	Delivered
1	AirQUIS User documentation – Emission Inventory Module (Draft)	Delivered
Services		
1	Procedure for reporting problems	Delivered
1	Procedure for modifying the system	Delivered
1	PC-inventory list	Delivered
1	Installation of AirQUIS 2003	Delivered
1	Installation of Backup system	Delivered
1	Installation of server	Delivered
1	Installation of client-PC (AirQUIS)	Delivered
1	Installation of client-PC (VTD)	Delivered
1	Training of AirQUIS 2003	Delivered
1	Training of System maintenance	Delivered
Other		
5	AIT 35 GB backup tape 64Kb	Delivered
1	Norton Ghost 7.5 boot floppy disk	Delivered

Appendix C4: Summary of the AirQUIS technical implementation

Department of Science,
Technology and Environment (DOSTE)
The Norwegian Institute for Air Research (NILU)

Memo

Title	**Summary of the AirQUIS technical implementation**
Purpose	Install, adapt and training of AirQUIS at DONRE
Distribution	Le Van Khoa (LVK), Vo Thanh Dam (VTD), Bjarne Sivertsen (BS) and Rune Oedegaard (RuO)
Author	The Nguyen Thanh (TNT)
Date	26 November 2003
Reference No	O-101143

This memo summarizes the AirQUIS technical implementation on the daily basis during the stay of the NILU team.

The technical implementation of AirQUIS was done from 03 to 14 November.

03 November 2003
The DONRE team and the NILU had a start up meeting going through the activities to be done during the NILU stay.

A time schedule was provided by NILU. Please see the appendix.

The equipments (server, workstation and backup unit) including the operative system were installed on the existing network at DONRE.

A PC-Inventory list was provided by NILU.

04 November 2003
The following elements have been installed and verified:

- The AirQUIS server with Oracle database
- The Veritas backup software on the AirQUIS server
- The AirQUIS application on the client-PC
- The AirQUIS server and the AirQUIS client-PC connected to the network printer HP Laser Jet 6P on CDCS
- Configuration of the Automatic Data Import Module for importing measurement data from 9 stations through exported ASCII-files from the existing EnviMan application.

05 November 2003
Adaptation, testing and training of the Automatic Data Import Module for DONRE needs. This routine will be scheduled to run automatically at DONRE.

06 November 2003
Adaptation, testing and training of the Automatic Data Import Module for DONRE needs continues.

Configuration, testing and training of the AQI (Air Quality Index) for HCMC. This routine will be scheduled to run automatically at DONRE.

Testing of the GIS data from DONRE. An updated shape of the HCMC with the administrative district regions was provided by DONRE.

06 November 2003
Adaptation, testing and training of the AQI for DONRE needs.

Training of using the GIS and Measurement module with focus on importing data through the AirQUIS templates.

07 November 2003
Adaptation, testing and training of the AQI for DONRE needs continues.

Importing of historical data through the AirQUIS templates continues.

Training of verifying data in the AirQUIS database.

10 November 2003
Adaptation, testing and training of the AQI for DONRE needs continues.

Training of the AirQUIS Measurement Module with focus on Quality Assurance and Statistics with DONRE data.

11 November 2003
Training of the AirQUIS Measurement Module with focus on Quality Assurance and Statistics with DONRE data continues.

Testing of the Point sources data from the industries. DONRE will do the import by themselves.

Understanding the information needed for collecting the Line sources (traffic data).

12 November 2003
Final verification of the features needed in Automatic Data Import and AQI together with DONRE.

Test backup of the AirQUIS database.

13 November 2003
Training of system maintenance of AirQUIS.

The following documentations were provided by NILU:
- Delivery list (what have been delivered by NILU on this mission)
- PC-inventory list
- Password list

- Backup Log Form
- Cloning Log Form
- Procedure for modifying the AirQUIS system
- Procedure for reporting problems

14 November 2003
Summary meeting of the activities done at DONRE and activities to be followed up by NILU and DOSTE.

Appendix D

Task4. Assure system integration

Appendix D1: Computers designed to integrate to existing system

To assure that data can be adequately transferred to the new GIS based database NILU provided the following **server** with AirQUIS installed:

Brand	**Compaq MT 530 or newer**
CPU	Intel Pentium III Xeon – 512 Kb, 1 GHz or newer/faster
Hard disk	4 x 36 GB SCSI hot-swap
RAID Adapter	Supports RAID 0 and RAID 5
RAM	1 GB
Graphical Adapter	Supports 1280 x 1024 or higher resolution, 32-bit true colour quality
Network	TP - 100 Mbit
Monitor	19" supports 1280 x 1024 or higher resolution and 32-bit true colour quality
Case	Rack or Tower. A rack model is preferred because DOSTE has a standard rack containing a 3COM HUB and a patch panel.
Other	Keyboard, scroll mouse, com port, parallel port and USB ports
Operative system	MS Windows 2000 Server English with SP 3 or newer
Warranty	Minimum 1 year
Service agreement	Option for yearly service agreement after the warranty period

Client PCs were also provided, such as:

Brand	**Local**
CPU	Intel Pentium 4, 2GHz or faster
Hard disk	IDE 20 GB or larger
RAM	512 MB
Operative system	Certified for MS Windows XP English with SP 1 or newer

NILU purchased 1 client-PC and 1 Server-PC for the project.

DOSTE and NILU will need at least 1 week to prepare and install
The operative system and connections to the existing network was undertaken during Mission 3.

Appendix D2: PC-Inventory List

PC-Inventory List

Server	
Name	HCMC-AIRQUIS
Workgroup	ENVIMAN
PC model	Compaq Proliant ML350 (Xeon) T03 X220-51, Serial nr. 7J33KT416016
OS	Windows 2000 SP 4
RAM	1 GB
Disk space	68 GB x 2 (One spare disk)
Database	Oracle 9.2
Client	
Name	AirQUIS Client
Workgroup	ENVIMAN
PC model	Local Brand Nova
OS	Windows XP Professional
RAM	512 MB RAM
Disk space	40 BG x 2 (One spare disk)
Application	AirQUIS 2003 version 2.0.330
Name	DamDesktop
Workgroup	ENVIMAN
PC model	Local Brand
OS	Windows XP Professional
RAM	256 MB RAM
Disk space	18 GB x 2
Application	AirQUIS 2003 version 2.0.330

Appendix E

Task 5. Quality Assurance (QA/QC)

Appendix E: Training agenda for the week of August 4-8, 2003 at the Best Western Inn by the Sea, La Jolla, CA

Monday SO_2 8/4/03		
Instructor	**Time**	**Topic**
	9:00 – 9:50	Welcome to the Class
	9:50 – 10:00	Break
	10:00 – 10:50	Principle of Operation
	10:50 – 11:00	Break
	11:00 – 12:00	Menu items (test features/Diag/range/cal menu)
	12:00 – 1:00	Lunch
	1:00 – 1:50	Maintenance/Start up (filters/orifices/flows/o-rings)
	1:50 – 2:00	Break
	2:00 – 2:50	Labs (elects/flows/zero/span/et-ot)
	2:50 – 3:00	Break
	3:00 – 3:50	Labs (elects/flows/zero/span/et-ot)
Tuesday NO_x 8/5/03		
Instructor	**Time**	**Topic**
	9:00 – 9:50	Principle of Operation
	9:50 – 10:00	Break
	10:00 – 10:50	Principle of Operation
	10:50 – 11:00	Break
	11:00 – 12:00	Menu items (test features/Diag/range/cal menu)
	12:00 – 1:00	Lunch
	1:00 – 1:50	Maintenance/Start up (filters/orifices/flows/o-rings)
	1:50 – 2:00	Break
	2:00 – 2:50	Labs (elects/flows/zero/span/et-ot)
	2:50 – 3:00	Break
	3:00 – 3:50	Labs (elects/flows/zero/span/et-ot)
Wednesday CO 8/6/03		
Instructor	**Time**	**Topic**
	9:00 – 9:50	Principle of Operation
	9:50 – 10:00	Break
	10:00 – 10:50	Principle of Operation
	10:50 – 11:00	Break
	11:00 – 12:00	Menu items (test features/Diag/range/cal menu)
	12:00 – 1:00	Lunch
	1:00 – 1:50	Maintenance/Start up (filters/orifices/flows/o-rings)
	1:50 – 2:00	Break
	2:00 – 2:50	Labs (elects/flows/zero/span/et-ot)
	2:50 – 3:00	Break
	3:00 – 3:50	DAS
Thursday Ozone 8/7/03		
Instructor	**Time**	**Topic**
	9:00 – 9:50	Principle of Operation
	9:50 – 10:00	Break
	10:00 – 10:50	Principle of Operation
	10:50 – 11:00	Break
	11:00 – 12:00	Menu items (test features/Diag/range/cal menu)
	12:00 – 1:00	Lunch
	1:00 – 1:50	Maintenance/Start up (filters/orifices/flows/o-rings)
	1:50 – 2:00	Break
	2:00 – 2:50	Labs (elects/flows/zero/span/et-ot)
	2:50 – 3:00	Break
	3:00 – 3:50	APICOM

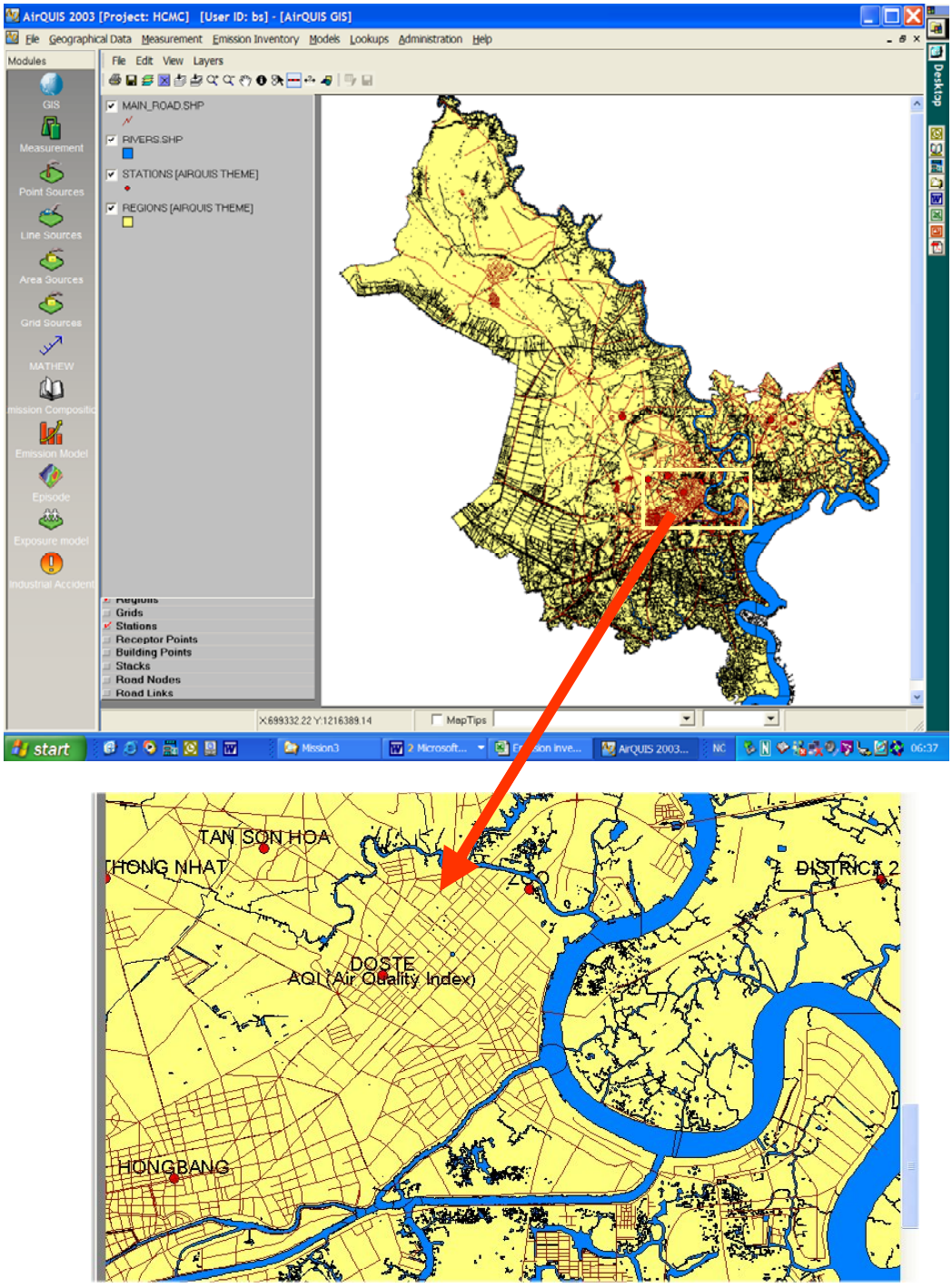
Friday calibrator 8/8/03		
Instructor	**Time**	**Topic**
	9:00 – 9:50	Principle of Operation
	9:50 – 10:00	Break
	10:00 – 10:50	Principle of Operation
	10:50 – 11:00	Break
	11:00 – 12:00	Menu items (test features/Diag/range/cal menu)
	12:00 – 1:00	Lunch
	1:00 – 1:50	Maintenance/Start up (filters/orifices/flows/o-rings)
	1:50 – 2:00	Break
	2:00 – 2:50	Labs (elects/flows/zero/span/et-ot)
	2:50 – 3:00	Break
	3:00 – 3:50	Labs (elects/flows/zero/span/et-ot)

Appendix F

Task 6. Install AirQUIS

Appendix F1: GIS in AirQUIS

The pictures below illustrate the GIS system as shown in AirQUIS for Ho Chi Minh City.



Appendix G

Task7. Air Quality Modelling

Appendix G1: Point sources collected

November 2003

Industrial Plant Register						
Industrial Plant ID	Name of Industrial Plant	Source sectors ID	Source sectors Name	Region ID	Region Name	Owner ID
80100001	Công ty nư?c gi?i khát Chương Dương	40605	beverage	801	Qu?n 1	
80400001	Công ty TNHH thu? tinh Vi?t Nam - Malaysia	30317	glass furnace	804	Qu?n 4	
80500001	Công ty Bia Sài Gòn	40606	brewery	805	Qu?n 5	
80500002	Nhà máy đi?n Ch? Quán	10102	power plant	805	Qu?n 5	
80700001	Nhà máy thép Nhà Bè	30301	steel furnace	807	Qu?n 7	
80700002	Công ty d?u ăn Golden Hope - Nhà Bè	40607	vegetable oil	807	Qu?n 7	
80800001	Công ty liên doanh d?t Sài Gòn Joubo	60203	textile dye	808	Qu?n 8	
80900001	Công ty C? ph?n gi?y Xuân Đ?c	30323	paper recycle	809	Qu?n 9	
80900002	Công ty d?t Phong Phú	60201	textile	809	Qu?n 9	
80900003	Công ty d?t may Phư?c Long	60201	textile	809	Qu?n 9	
81100001	Công ty d?t may Đông Á	60201	textile	811	Qu?n 11	
81200001	Công ty TNHHgi?y và bao bì Đ?ng Ti?n	30322	paper and package	812	Qu?n 12	
81200002	Công ty c? ph?n th?c ph?m Thiên Hương	40607	food processing, noodle	812	Qu?n 12	
81200003	Cong ty TNHH Sai Gon Vewong	40607	food, glutamat	812	Qu?n 12	
81200004	Công ty TNHH d?t may Thái Tu?n	60201	textile	812	Qu?n 12	
81200005	Công ty TNHH gi?y và bao bì Phú Th?nh	30322	paper and package	812	Qu?n 12	
81400001	Công ty d?t may Gia Đ?nh	60201	textile	814	Bình Th?nh	
81700001	Phân xư?ng nhu?m, công ty c? ph?n d?t may Quy?t Th?ng	60203	dye factory	817	Gò V?p	
81800001	Công ty TNHH Gi?y và bao bì Tân Hoà Hi?p	30322	paper and package	818	Huy?n Hóc Môn	
81800002	Công ty TNHH SX TM Ph?m Thu			818	Huy?n Hóc Môn	
81800003	Công ty thu?c lá 27/7	80604	tobaco	818	Huy?n Hóc Môn	
81900001	Công ty TNHH Đi?n Hi?p Phư?c	10102	power plant	819	Huy?n Nhà Bè	
82100001	Công ty d?t may Th?ng L?i	60203	textile dye	821	Qu?n Tân Bình	
82100002	Công ty d?t may Thành Công	60203	textile dye	821	Qu?n Tân Bình	
82100003	Công ty k? ngh? th?c ph?m Vi?t Nam	80602	slaughter, food processing	821	Qu?n Tân Bình	
82100004	Công ty d?t kim Đông Phương	60201	textile	821	Qu?n Tân Bình	
82100005	Công ty c? ph?n Mai Lan	30321	paper and pulp	821	Qu?n Tân Bình	
82100006	Nhà máy d?u Tư?ng An	40607	vegetable oil	821	Qu?n Tân Bình	
82100007	Công ty Vifon Acecook	40407	noodle	821	Tân Bình	
82100008	Xí nghi?p ch? bi?n hàng xu?t kh?u C?u Tre	40407	food processing	821	Tân Bình	
82100009	Nhà máy d?u Tân Bình	40407	vegetable oil	821	Tân Bình	
82200001	Công ty CP gi?y V?nh Huê	30322	paper	822	Th? Đ?c	
82200002	Công ty d?t Vi?t Th?ng	60203	textile dye	822	Th? Đ?c	
82200003	Nhà máy thép Th? Đ?c	30301	steel furnace	822	Th? Đ?c	
82200004	Công ty gi?y Đông Nam	30322	paper	822	Th? Đ?c	

The following two tables presents some of the information available for the point sources collected until 25 November 2003.

Further information needed in the templates such as source identification, process type and emission factors still remains to be obtained.

Stack ID	Stack name	X Co-ordinate	Y Co-ordinate	Stack height (m)	Stack Diameter (m)	Gas Temperature (C)	Gas Velocity (m/s)	Gas Flow Rate (m^3/h)
8010000101	? ng khói 8010000101	106.683	10.8476	15.00	0.55	288.00	18.60	15 882
8010000101	? ng khói 8010000101	106.642	10.8488	25.00	0.70	208.00	34.30	47 550
8050000101	? ng khói 8050000101	106.561	10.7626	20.00	1.00	248.00	17.50	49 568
8050000102	? ng khói 8050000102	106.677	10.8086	18.00	1.00			
8050000201	? ng khói 8050000201	106.677	10.8086	15.00	0.79	377.00	26.70	47 169
8050000202	? ng khói 8050000202	106.677	10.8086	15.00	0.79			
8050000203	? ng khói 8050000203	106.677	10.8086	15.00	0.79			
8050000204	? ng khói 8050000204	106.664	10.8109	15.00	0.79			
8070000101	? ng khói 8070000101	106.709	10.8008	20.00	1.80	52.00	48.50	443 958
8070000102	? ng khói 8070000102	106.71	10.8004	24.64	1.10			
8070000103	? ng khói 8070000103	106.709	10.7996	30.00	1.26			
8070000201	? ng khói 8070000201	106.714	10.7931	9.00	0.80	243.00	17.70	40 558
8070000202	? ng khói 8070000202	106.656	10.7963	7.00	0.80	187.00	16.50	29 807
8070000203	? ng khói 8070000203	106.645	10.8591	30.00	0.40	324.00	22.00	9 941
8070000204	? ng khói 8070000204	106.655	108717	30.00	0.40			
8080000101	? ng khói 8080000101	106.695	10.8701	10.00	0.60	160.00	15.90	16 206
8090000101	? ng khói 8090000101	106.723	10.8474	12.00	0.50	231.00	16,0	12
8090000102	? ng khói 8090000102	106.723	10.8473	15.00	0.50			
8090000201	? ng khói 8090000201	106.73	10.8521	16.00	0.30	282.00	18,0	13
8090000202	? ng khói 8090000202	106.73	10.8521	16.00	0.90			
8090000203	? ng khói 8090000203	106.73	10.8521	16.00	0.90			
8090000301	? ng khói 8090000301	106.73	10.8521	15.00	0.65	195.00	17,1	20
8090000302	? ng khói 8090000302	106.731	10.8866	15.00	0.50	181.00	20,7	15
8090000303	? ng khói 8090000303	106.732	10.8734	15.00	0.50	376.00	15,6	7
8090000304	? ng khói 8090000304	106.732	10.8735	15.00	0.40	122.00	16,6	11
8110000101	? ng khói 8110000101	106.643	10.8483	13.50	0.65	194.00	17.90	8 110
8110000102	? ng khói 8110000102	106.561	10.7686	13.50	0.65	180.00		
8120000101	? ng khói 8120000101	106.695	10.8701	20.00	0.35	255.00	16.90	5 852
8120000201	? ng khói 8120000201	106.695	10.87	16.00	1.10	312.00	21.40	40 731
8120000301	? ng khói 8120000301	106.627	10.9056	14.00	0.65	202.00	16.20	33 142
8120000302	? ng khói 8120000302	106.618	10.9054	24.00	0.85	205.00	16.60	19 830
8120000401	? ng khói 8120000401	106.643	10.8129	12.00	0.60	210.00	17.10	17 516
8120000402	? ng khói 8120000402	106.645	10.8546	12.50	0.60	194.00	16.80	17 085
8120000501	? ng khói 8120000501	106.675	10.8662	6.00	0.25	131.00	15.10	3 120
8140000101	? ng khói 8140000101	106.643	10.8492	18.00	550.00	241.00	17.70	14 608
8140000102	? ng khói 8140000102	106.645	10.8546	19.00	500.00	283.00	19.20	13 550
8140000103	? ng khói 8140000103	106.645	10.8564	18.00	0.50			
8140000104	? ng khói 8140000104	106.645	10.8564	18.00	0.50			
8170000101	? ng khói 8170000101	106.643	10.8096	12.00	0.60	353.00	20.30	20 652
8180000101	? ng khói 8180000101	106.605	10.8838	12.00	0.40	194.00	15,5	7
8180000201	? ng khói 8180000201	106.645	10.847	18.00	400.00	84.00	13,5	6
8180000202	? ng khói 8180000202	106.644	10.847	18.00	300.00	154.00	16.00	4
8180000301	? ng khói 8180000301	106.643	10.8491	15.00	500.00	207.00	16,4	12
8190000101	? ng khói 8190000101	106.714	10.7384	150.00	0.45	158.00	24.20	1 383 238
8210000101	? ng khói 8210000101	106.643	10.8492	12.00	0.50	287.00	17,0	12
8210000102	? ng khói 8210000102	106.643	10.8489	20.00	0.95	210.00	18,0	48
8210000103	? ng khói 8210000103	106.643	10.9464	15.00	0.60			
8210000104	? ng khói 8210000104	106.644	10.847	12.00	0.50			
8210000201	? ng khói 8210000201	106.649	10.8297	10.00	0.90	250.00	19,0	44
8210000301	? ng khói 8210000301	106.649	10.8297	18.00	0.70	218.00	18,0	25
8210000302	? ng khói 8210000302	106.65	10.8321	18.00	0.65			
8210000401	? ng khói 8210000401	106.646	10.8537	10.00	0.45	120.00	14,0	9
8210000402	? ng khói 8210000402	106.646	10.8536	10.00	0.45			
8210000501	? ng khói 8210000501	106.735	10.8541	18.00	0.50	120.00	15,0	11
8210000601	? ng khói 8210000601	106.735	10.8541	15.00	0.95	273.00	24,0	62
8210000602	? ng khói 8210000602	106.735	10.854	15.00	0.30	287.00	11,0	5
8210000701	? ng khói 8210000701	106.683	10.8476	14.00	0.80	218.00	20.60	37 335
8210000702	? ng khói 8210000702	106.683	10.8475	12.00	0.50	168.00	17.10	20 447
8210000801	? ng khói 8210000801	106.643	10.8483	12.00	0.40	302.00	18.60	8 394
8210000802	? ng khói 8210000802	106.644	10.8482	12.00	0.40	112.00		
8210000901	? ng khói 8210000901	106.644	10.848	12.00	0.60	226.00	18.10	18 801
8210000902	? ng khói 8210000902	106.655	10.8189	12.00	0.40			
8210000903	? ng khói 8210000903	106.664	10.8108	12.00	0.30	372.00	18.80	4 179
8210000904	? ng khói 8210000904	106.655	10.819	15.00	0.28	297.00	19.20	4 260
8220000101	? ng khói 8220000101	106.732	10.8734	16.00	500.00	110.00	14,3	10
8220000102	? ng khói 8220000102	106.731	10.8864	7,5	250.00	307.00	18,3	3
8220000103	? ng khói 8220000103	106.731	10.8874	7,5	250.00	307.00	18,3	3

Appendix G2: Traffic counting

Department of Science,
Technology and Environment (DOSTE)
The Norwegian Institute for Air Research (NILU)

Memo

Title	Traffic counting
Purpose	Instructions and a simplified chart for undertaking simple traffic counts have been developed as instruction to the DONRE staff.
Distribution	Le Van Khoa (LVK), Ngo Thanh Duc (NTD), Vo Thanh Dam (VTD), Nguyen Bao Quoc (NBQ), and The Nguyen Thanh (TNT)
Author	Bjarne Sivertsen (BS)
Date	19 November 2003
Reference No	O-101143

To support the staff in collecting some basic traffic data as a beginning of using the emission inventory templates for line sources, a simple chart was developed for collecting adequate information.

The following columns have to be filled in as part of the AirQUIS emission templates:

HCMC Data needed for road traffic input data

Road Link ID	Road Link Name	Road Class ID	Road width 1(m) (Start to End)	Direction (1 = Start to End Node, 2 = End to Start Node	Annual Daily Traffic	Free Flow Speed (km/h)	Link Direction	Vehicle Class ID	Vehicle Class Name	Vehicle Class Fraction %
1	Hai ba Trung Lib	2	15	1	108000	30	1	1		15
							1	2		3
							1	3		2
							1	4		80
				2	97300	30	2	1		12
							2	2		3
							2	3		1
							2	4		84
2	Nguyen Dunh Chien	2	12	1	140000	40	1	1		9
							1	2		1
							1	3		1
							1	4		89
3	DienBien Phu	2	15	1	134000	35	1	1		4
							1	2		1
							1	3		1
							1	4		94

The columns presented above relates to the static traffic data, to the dynamic data sheet and to the road link vehicle distribution.

Road Node ID	EW Coordinate	NS Coordinate
3000	685382	1192725
3001	685602	1192544
3002	685145	1192916
4003	684939	1192245
1002	684041	1191833
1003	684435	1192210
1004	684564	1192338

Road classes, road vehicle classes and road nodes have to be defined first. To obtain the information necessary for the column shown above it may be sufficient to visit a selected number of main streets in HCMC. The main streets should be appointed first and specified by road node co-ordinates and road link names.

Examples of selected road classes and main registered vehicle classes are shown on the following figures.

Road Classes	
ID	Road Class Name
1	Major road / transit road
2	City centre street
3	Residential area street
4	Industrial area street
5	Local road

ID number	Registrated Vehicle Class (RVC) Name
1	Light duty vehicles
2	Heavy duty vehicles
3	Buses
4	Motor cycles

The main vehicle classes are again divided into a number of sub-classes; Emission Calculated Vehicle Classes (ECVC). Motorcycles are e.g. preliminary divided into:

31 Motorb< 50cm3
32 Motorb> 50cm3 2 stroke
33 Motorb> 50cm3 4stroke
34 3-wheeler
35 Motorbike Honda
36 Motorbike Angel
37 Motorbike Dream
38 Motorbike Yamaha
39 Motorbike Suzuki
40 Motorbike
41 Motorbike
42 Motorbike

An example of three road links where simple counting have been undertaken is shown in the following figure:

Road Link ID	Road Link Name	Road Class ID	Road Class Name	Description	Start Node ID	End Node ID	Length in meter
1	Hai ba Trung Lib	2	city		3001	3002	618
2	Nguyen Dunh Chie	2	city		3000	4003	657
3	DienBien Phu	2	city		1002	1004	726

The simplified counting in selected streets can be undertaken using the following chart.

City	Street	Street	Date	Hour		Direc	Vehic	Class (%)				ADT
	Excact address	width		start	stop	tion	numbr	1 cars	2 heavy	3 bus	4 m-cycl	estimate
HCMC	HaiBa Trong at Liberty1	9	16.Nov.03	1800	1805	S	500	15	3	2	80	108000
				1800	1805	N	450	15	2	1	92	97200
HCMC	Dien Bien Phu at Doste	12	17.Nov.03	1610	1615	NE	550	3.5	1	0.5	95	118800
	Dien Bien Phu at Doste	12	17.Nov.03	1730	1735	NE	650	4	1	1	94	140400

Counts should be undertaken in the same street several times at different hours of the day. Each time it seems to be sufficient to count over about 5 to 10 minutes. Count first the total number of vehicles. Repeat the counting and estimate the number of private cars, heavy duty vehicles and buses. Estimate the percentage of these.

The annual average daily traffic (ADT) can then be estimated taking into account the total number of hours in a typical day. The chart has been made available to the DONRE staff in excel to simplify the estimate of ADT numbers.

The daily, weekly and seasonal variation in the traffic density should be indicated in other tables. Emission estimates are based on emission factors to be given in the chart ECVC basic factors.

Appendix G3: Traffic and emission factors for HCMC

The following data have been taken from Report on Issue no. 2 "Energy Efficiency Improvement of Urban Transport System and Mitigation of GHGs and other harmful emissions, Case study of Ho Chi Minh City, Vietnam.(April 2002).

The traffic will have to be divided into classes such as given in the following table:

No.	Variable	Description	Fuel	Starting year
1.	MG	Motorbike	Gasoline	Existing
2.	CG	Car/Automobile	Gasoline	Existing
3.	BD	Bus (30 seats)	Diesel	Existing
4.	LG	3-wheeler Lambro (8 seats)	Gasoline	Existing
5.	TG	Taxi	Gasoline	Existing
6.	TL	Taxi	LPG	2002
7.	VG	Van (10 seats)	Gasoline	2002
8.	MC	Motorbike with CVID	Gasoline	2001
9.	ME	Electric bike (1 seats)	Electricity	2005
10.	MT	Metro	Electricity	2005
11.	TR	Express city train	Electricity	2005

Source: assumption of this study

Emission factor (g/km)

	Fuel	CO2	CO	NOx	SO2	HC	SPM	Lead
Motorbike	**Gasoline**	15.45	17.00	0.23	0.03	11.88	0.20	0.00
Automobile	**Gasoline**	189.00	3.80	0.30	0.18	0.40	0.07	0.05
Bus	**Diesel**	361.02	2.51	6.10	1.86	1.12	1.40	
Lambro	**Gasoline**	61.38	16.09	0.69	0.05	0.50		
Taxi -gasoline	**Gasoline**	189.00	3.80	0.30	0.18	0.40	0.07	0.05
Electric bike	**Electricity**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Van	**Gasoline**	55.10	3.71	0.23		0.04		
Taxi - LPG	**Gasoline**	180.00	3.71	0.23		0.04		
Motorbike-CVID	**Gasoline**	13.95	3.95	0.20	0.00			
Metro	**Electricity**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Express city train	**Electricity**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Minibus	**Diesel**	110.05	110.05	3.26	0.18	20.73		

Source: Report #1, DOSTE 2000

Note: emission factors correspond to average speed of 25-30 km/h.

Possible mitigation scenarios

Some options are available for lightly mitigating of emission in this scenario. They have been applied more or less in fact as described in the first four chapters of the issue, including:

- Using electric bike
- Using LPG-transformed taxi
- Using CVID (computerized variable ignition device) for motorbike.

Emission factors from India
Petrol and Diesel Driven Vehicles

Year	Vehicle Type	Type of Pollutant in gm / km			
		CO	NOX	HC	PM
1986 - 1990	Two	6.50	0.03	3.90	0.23
1991 -1995	Wheelers	6.50	0.03	3.90	0.23
1996 - 2000	(2 Stroke)	4.00	0.06	3.30	0.10
2001 -2005		2.20	0.07	2.13	0.05
1986 - 1990	Two	3.00	0.31	0.80	0.07
1991 -1995	Wheelers	3.00	0.31	0.80	0.07
1996 - 2000	(4 Stroke)	2.60	0.30	0.70	0.06
2001 -2005		2.20	0.30	0.70	0.05
1986 - 1990	Three	14.00	0.05	8.30	0.35
1991 -1995	Wheelers	14.00	0.05	8.30	0.35
1996 - 2000	(2 Stroke)	8.60	0.09	7.00	0.15
2001 -2005		4.30	0.11	2.05	0.08
1986 - 1990	Passenger	9.80	1.80	1.70	0.06
1991 -1995	Cars	9.80	1.80	1.70	0.06
1996 - 2000	(Petrol	3.90	1.10	0.80	0.05
2001 -2005	Driven)	1.98	0.20	0.25	0.05
1986 - 1990	Passenger	7.30	2.77	0.37	0.84
1991 -1995	Cars	7.30	2.77	0.37	0.84
1996 - 2000	(Diesel	1.20	0.69	0.37	0.42
2001 -2005	Driven)	0.90	0.50	0.13	0.07
1986 - 1990	LCV	8.70	3.15	0.34	0.80
1991 -1995		8.70	3.15	0.34	0.80
1996 - 2000		6.90	2.49	0.28	0.50
2001 -2005		5.10	1.28	0.14	0.20
1986 - 1990	HCV	5.50	9.50	1.78	1.50
1991 -1995		5.50	9.50	1.78	1.50
1996 - 2000		4.50	8.40	1.21	0.80
2001 -2005		3.60	6.30	0.87	0.28
1986 - 1990	Buses	5.50	19.00	1.78	3.00
1991 -1995		5.50	19.00	1.78	3.00
1996 - 2000		4.50	16.30	1.21	1.60
2001 -2005		3.60	12.60	0.87	0.64

Source: CPCB, New Delhi

Presented by Sudhir Singhal (Indian Institute of Petroleum) in "Air Pollution as a Climate Forcing" Workshop in April 29 - May 4, 2002 at the East-West Center, Honolulu, Hawaii. However, I doubt if the PM factors given are applicable for PM_{10}.

Appendix G4: Vehicle classes for emission estimates (AirQUIS template: ECVC)

The following table indicates a distribution of vehicle classes that can be used a starting point in HCMC. Cars with ID 1 to 6 may be used in the existing car fleet. Further identification of heavy vehicles and buses as well as motorcycles could be based on the table below.

ID	Name	Average Model year	Average Driving Distance (km/year)	Vehicle Class ID	Vehicle Class Name	Fuel ID	Fuel Name
1	PreCat	1986	13200	1	cars	8	petrol
2	US 83/87/90	1992	14500	1		8	
3	EURO 1 G	1996	14200	1		8	
4	EURO 1 D	1996	15900	1		19	Diesel
5	EURO 2 G	1999	13800	1		8	
6	EURO 2 D	1999	18100	1		19	
7	EURO 3 G	2003	0	1		8	
8	EURO 3 D	2003	0	1		19	
9	EURO 4 G	2007	0	1		8	
10	EURO 4 D	2007	0	1		19	
11	EURO 1 DHLL	1994	17800	2	heavy veh.	19	
12	EURO 1 DHLM	1994	19700	2		19	
13	EURO 1 DHLH	1994	33000	2		19	
14	EURO 1 DHB	1994	43400	3		19	
15	EURO 2 DHLL	1998	21500	2		19	
16	EURO 2 DHLM	1998	24600	2		19	
17	EURO 2 DHLH	1998	40400	2		19	
18	EURO 2 DHB	1998	44100	3	buses	19	
19	EURO 3 DHLL	2003	0	2		19	
20	EURO 3 DHLM	2003	0	2		19	
21	EURO 3 DHLH	2003	0	2		19	
22	EURO 3 DHB	2003	0	3		19	
23	EURO 4 DHLL	2007	0	2		19	
24	EURO 4 DHLM	2007	0	2		19	
25	EURO 4 DHLH	2007	0	2		19	
26	EURO 4 DHB	2007	0	3		19	
27	EURO 5 DHLL	2010	0	2		19	
28	EURO 5 DHLM	2010	0	2		19	
29	EURO 5 DHLH	2010	0	2		19	
30	EURO 5 DHB	2010	0	3		19	
31	Motorb< 50cm3			4	motorbikes	8	
32	Motorb> 50cm3 2 stroke			4		8	
33	Motorb> 50cm3 4stroke			4		8	
34	3-wheeler			4		8	
35	Motorbike Honda			4		8	
36	Motorbike Angel			4		8	
37	Motorbike Dream			4		8	
38	Motorbike Yamaha			4		8	
39	Motorbike Suzuki			4		8	
40	Motorbike			4		8	
41	Motorbike			4		8	
42	Motorbike			4		8	

Appendix G5: Procedure for obtaining traffic data

Department of Science,
Technology and Environment (DOSTE)
The Norwegian Institute for Air Research (NILU)

Memo

Title	Procedure for obtaining traffic data
Purpose	Prepared on request to have a working procedure for collecting traffic emission data
Distribution	Le Van Khoa (LVK), Vo Thanh Dam (VTD),
Author	Bjarne Sivertsen (BS)
Date	25 November 2003
Reference No	O-101143

The memo on traffic counting dated 19 November 2003 indicates what data are needed for obtaining traffic emission data. This memo has been developed to illustrate the sequence of obtaining the traffic emission data.

Major streets and roads have been selected (see map at Mr Dam). Then identify the road node positions. Import UTM co-ordinates from AirQUIS GIS to the templates. Further some main road links will have to be appointed and registered by start and end nodes, before counting can start. Some simple counts were undertaken as examples at 3 road links in District 3 of HCMC

The procedure's first phase is undertaken defining road classes and vehicle classes

Road classes	List of road classes
Registrated Vehicle Classes (RVC)	List of vehicle classes. RVCs are vehicle classes for which one can receive registered data from traffic counts etc.

Second we have to define parameters for the static traffic data. Based on the main roads that have been selected (on map and imported to templates) start collecting dynamic traffic data.

Road nodes	In AirQUIS roads are defined as lines between two points. Those points are called road nodes. Identify as many road nodes as you believe is necessary to identify the road links.
Static traffic data	A static classification of the road links e.g. lane width, length, gradient etc. A road link is defined as a road segment between two road nodes where classification is homogenous. (See memo 10 Nov 2003)
Dynamic traffic data	Describes the traffic flow on each road link. Use the procedures given in Memo (Excel count sheet)
Vehicle distribution	The percentage (%) of Registered Vehicle Classes (RVC) and time variation, which can be allocated to a certain road link.

Finally we will have to define the vehicle classes, which are specific for emission factors (ECVC). These classes are given in Appendix G4 Mission 3 report.

Emission inventory – Line sources Traffic emission factors	
Emission Calculated Vehicle Classes (ECVC)	The sub class of Registered Vehicle classes (RVC) is named Emission Calculated Vehicle Classes (ECVC). Emission Calculated Vehicle Classes separates between different technologies.
ECVC – RVC Distribution	Defines the coupling between the Emission Calculated Vehicle Classes (ECVC) and Registered Vehicle Classes (RVC).
ECVC – Fuel Consumption	Give the range of fuel consumption for each ECVC depending on the speed.
ECVC Basic and Ageing Factors	Basic and aging factors give basic factor and ageing factor for each ECVC. (Emission factors will be evaluated by NILU)
ECVC Speed Dependency Factors	List of combination of ECVC, component and speed for components that has its own speed dependency factor.
ECVC Road Gradient Factors	Scaling factors for different slopes for each ECVC and component combination.
ECVC NO_2 Percentage in NO_x	Emission of NO_2 as a percentage of the total NOx emission for all ECVCs and for the different road gradients.

The input data for traffic emissions are generally internationally given. However, for HCMC some factors have been used in earlier studies, as presented in Appendix G3 of the Mission 3 report.

Appendix H

Task8. Field Operations

Appendix H1: Air Quality Monitoring Status, HCMC – HEIA project

Department of Science,
Technology and Environment (DOSTE)
The Norwegian Institute for Air Research (NILU)

Memo

Title	Air Quality Monitoring Status, HCMC - HEIA project
Purpose	To summarize the status of all air quality monitoring stations and instruments operated in HCMC.
Distribution	Le Van Khoa (LVK), Vo Thanh Dam (VTD), Nguyen Bao Quoc (NBQ), Le Sanh Quoc Tuan (LSQT), Tran Ngoc Thanh (TrNT), Nguyen Thanh Huy (NTH) and The Nguyen Thanh (TNT), Rolf Dreiem (RD)
Author	Bjarne Sivertsen (BS
Date	20 November 2003
Reference No	O-101143

A meeting was held on 20 November 2003 to go through and summarize the status of the air quality monitoring programme being operated by DONRE in HCMC.

I.D	HCMC Sites	ID	Area type	Param.	Status	Comments	Respon-sible
1	DOSTE	DO	Road side	SO_2	No	Garbage data, spare part missing, will be specified on the new spare part list – must be repaired	Mr Dam
				$NOx-NO_2$	Ok	November okay	
				CO	Ok	Holes in data, generally good	
				PM_{10}	error	Garbage data, OPSIS sampler not working	
				Ozone	error	Calibration error? Distribution looks okay in November, check calibration	Mr Quoc
				Temp	no data		
1b	DOSTE met tower	DM	Urban	WD (WW)	No	Error in transmission of wind data?	Smith
				WS (ane)	No		Vietnam
				T	No	Data 5 – 18 Sep 03, no data oct-nov	check new
				P	No		unit from
				Rad	No	Data 5-18 sep???	OPSIS
				RH	No	Data 5-16 sep?	
				WD (son)	No		
				WS (son)	No		
2	Hong Bang	HB	Road side	$NOx-NO_2$	Ok		
				CO	Ok		
				PM10	No	No data, OPSIS sampler in lab.	
				Ozone	Ok	OUT	

I.D	HCMC Sites	ID	Area type	Param.	Status	Comments	Respon-sible
3	Ton San Hoa	TS	Urban background	SO_2 NOx-NO_2 CO PM10 Ozone	no no Ok Ok? Ok	Spare part missing, in the new list! Monitor in for repair, spare part SF warning, data available OPSIS sampler, seem to be working Give data, system reset, power?	Mr Dam
4	Thu Duc	TD	Industrial/ residential	SO_2 NOx-NO_2 PM10	Neg Ok no	UV filter damaged. Need repair Seem to work fine OPSIS sampler in for repair- who?	Mr Dam OPSIS???
5	Thong Nhat	TN	Road side	SO_2 NOx-NO_2 CO PM10	Ok Ok OK OK	The best station, all data good!	
6	Binh Chan Educational	BC	Road side	NOx-NO_2 CO PM10	Neg Ok Ok	Bad data since 15 Sep.03, instrument need repair, RD informed.	Mr Dam / RD?
7	Zoo, District 1	ZO	Urban background	NOx-NO_2 PM10 Ozone	Ok Ok Ok	-"Clean" one spike? Data okay Good data – power problem solved	
8	District 2 PC	D2	Industrial / Residential	SO_2 NOx-NO_2 PM10 Ozone	Ok Ok Ok Ok	Have not retrieved data. Power problems due to payments corrected after 10 November.	
9	Quang Trung	QT	Urban background.	SO_2 NOx-NO_2 PM_{10} Ozone	Ok?? Ok No no	Problems with stabiliser, power, variable voltage, equal values -Some missing periods? 5-8 Sep, negative – spike 28 Aug? Data cannot be transmitted to data logger. No output from instrument Photo lamp, warning, need spare part	 Dam and RD ? API Spare part found, working

Two of the Danida sites have to be ensured to be top quality stations, as they represent important data into the system. These sites are: DOSTE shelter and Hong Bang station. At Hong Bang we may have to consider a new PM_{10} monitor, otherwise the instruments seem to work satisfactory. At DOSTE SO_2 and ozone will have to be repaired. PM_{10} and the temperature sensor should be available.

The meteorological data should be repaired and retrieved into the database as soon as possible. Mr Dinh from Smith Vietnam is presently checking with OPSIS to get hold of the missing part that was identified by Mr. Seved Grytting at the end of October 2002.

Mr. Seved Grytting wrote in his report that the WS002 IOMan module was not working which made all following IOMan modules not working either. The WM002 module was bypassed and the rest of the modules are now working fine.

A new module should have been sent from OPSIS free of charge. Smith Vietnam was no able to confirm this, and will check with OPSIS again.

The 3-axis ultrasonic anemometer sensor is installed on the same level as the other meteorological instruments. During Mr. Grytting's visist it was not possible to make a correct manual data poll of the sensor. The last 10% of the data string coming from the sensor was cut off (it was cut off in the middle of status value). It means that no ETX or checksum were received by IO256 software and therefore could not be accepted. The sensor may not have been working since installation.

OPSIS/Instrumatic will have to look into the problem and solve it!!

Appendix H2: Consumables received at DONRE

DESCRIPTION CONSUMABLES by Instrument Teknikk

	Model API 100A	**Qty**
FL0000001	Sintered Filter (002 - 024900)	3
HW0000020	Spring, Flow Control	3
OR0000001	O-Ring, Flow Control	6
PU0000022	Pump Rebuild Kit, KNF Model #NO5ATI	3
	Model API 200A	
OO2270100	Gasket (Rx Cell) Qty. 12	5
FL0000001	Sintered Filter (002 - 024900)	10
FL0000003	Filter, DFU (036-040180)	5
HW0000020	Spring, Flow Control	10
OR0000001	O-Ring, Flow Control	20
	Model API 300	
FL0000001	Sintered Filter (002 - 024900)	2
HW0000020	Spring, Flow Control	2
OR0000001	O-Ring, Flow Control	4
PU0000022	Pump Rebuild Kit, KNF Model #NO5ATI	2
	Model API 400	
FL0000001	Sintered Filter (002 - 024900)	3
HW0000020	Spring, Flow Control	3
OR0000001	O-Ring, Flow Control	6
PU0000022	Pump Rebuild Kit, KNF Model #NO5ATI	3
	For all of the above monitors	
	PTFE filters, 47mmØ , each 50 pcs	14
	Model API 701	
O05960000	Activated Charcoal, 6lbs.	5
O05970000	Purafil, 6 lbs., IZS OR Valve VER	5
O06900000	Charcoal Retainer Pads M100/M200	20
O06900100	Charcoal Retainer Pads M400	20
O16920000	Mole Sieve, 11 ozs (CH033)	5
FL0000016	Filter Element Paper for FL015	5
OR0000035	O-Ring, Drier Column	20
OR0000059	O-Ring, Scrubber	20
	ESM FH 62 - 1 Dust monitor	
KT149248091	GF10, Glass Fiber Filter Roll	5
	Opsis DL 256 PRO Datalogger	
	Fuse, 2,5A, Slow, 20 x 5 mm, each 10 pcs	1
	Fuse, 2A, Slow, 20 x 5 mm, each 10 pcs	1

	Server Proliant ML350 TO3 X220-51,	1
	Documentations, CD and cables	1
	Compaq AIT 35 Tape drive sn. 3E9934C0304	1

Appendix H3: Instrument spare part procedures

Air Pollution Monitoring - Instrument Spares

Part number	Item	Trans 1				Trans 2				Trans 3				Trans 4				Total
		Date	I/O	Quan	Name	Date	I/O	Quan	Name	Date	I/O	Quan	Name	Date	I/O	Quan	Name	
API Model 100A Spare Parts																		
002620100	UV Lamp Assembly	18/04/03	In	1														1
003290000	Thermistor Assembly 885-071600	18/04/03	In	1			Out	1										0
004020300	Sensor Board	18/04/03	In	1														1
013140100	Fan, PMT Cooler	18/04/03	In	1														1
FM000004	Flow Meter, 0-1000 cc	18/04/03	In	1														1
RL0000008	Solid State Relay, 12 Vdc	18/04/03	In	2														2
KIT000093	CD, UV Filter 214 NM	18/04/03	In	1														1
SW0000006	Overheat SW, Cell/Oven	18/04/03	In	1														1
SW0000008	Pressure Sensor	18/04/03	In	1														1
API Model 200A Spare Parts																		
002730000	Window 665 NM (002-013100)	18/04/03	In	1														1
011310000	Drier Assembly Complete with Flow Control	18/04/03	In	1														1
013140000	Fan, PMTCooler	18/04/03	In	1														1
CB0000001	FUSE 03, 1A	18/04/03	In	1														1
KIT000103	Replacement, Moly Guts, Lona, Type J (Guts only -TC, heater, cartridge)	18/04/03	In	1														1
PU0000006	Pump 220V/50Hz	18/04/03	In	1														1
PU0000011	607 Pump Rebuild Kit	18/04/03	In	1														1
API Model 300 Spare Parts																		
000941000	Orifice, 13 mil 1000 cc, Rx Cell	18/04/03	In	1														1
005511400	Assembly, Power Supply Module 230V/50Hz,CE	18/04/03	In	1														1
006110100	Assembly, Band Heater M300	18/04/03	In	1														1
007930000	Assembly, Fan, PSM (FA0000004 ASSY)	18/04/03	In	1														1
015810000	Source Assembly (with Adapter)	18/04/03	In	1														1
016910000	AKIT, Exp. Kit, CO Catalyst	18/04/03	In	1														1
KIT000109	Replacement, Opto Sensor M300	18/04/03	In	1														1
VA0000002	Solenoid, Stainless Steel, 24V	18/04/03	In	1														1
API Model 400A Spare Parts																		
005260200	UV Lamp Assembly, Source	18/04/03	In	1														1
006120200	Assembly, Ozone Generator Lamp w/ Piatail	18/04/03	In	1														1
011390300	Assembly, Power Supply Module - 230V/50 Hz, CE	18/04/03	In	1														1
024190000	Assy, Heater, Thermistor, UV Lamp, (M400A/M450)	18/04/03	In	1														1
KIT000076	M400A Absorption Tube Replacement	18/04/03	In	1														1
FL0000012	Filter,M400A Reference Scrubber	18/04/03	In	3														3
FA0000010	Fan	18/04/03	In	1														1
VA0000042	Valve, 3-Way, 1/8" tube	18/04/03	In	2														2
API Model 701 Spare Parts																		
014340000	Valve, Shuttle, Drier	18/04/03	In	1														1
FA0000006	Fan,115Vac	18/04/03	In	1														1
FL0000015	Filter, Air 150LPM, M701	18/04/03	In	1														1
VA0000011	Valve, 4-Way, Drier	18/04/03	In	1														1
VA0000014	Pressure Reaulator	18/04/03	In	1														1
VA0000016	Valve, CHECK	18/04/03	In	1														1
VA0000017	Valve, 2-Way (Water Drain)	18/04/03	In	1														1
005960000	Activated Charcoal,6 lbs	27/11/02	In	10		24.10.2003	In	5										15
005970000	Purafil, 6 lbs., IZS OR Valve VER	27/11/02	In	10		24.10.2003	In	5										15
006900000	Charcoal Retainer Pads M100/M200	27/11/02	In	20		24.10.2003	In	20			Out	6						34

ESM FH 62-1 Dust monitorins																		
KT14924809 1	GF10, Glass Fiber Filter Roll					24.10.2003	In	5										5
425451061	RPM reaulated pump, 220V, 50Hz	18/04/03	In	1														1
DPM10/01/0 0	Diaitel PM 10 Size selective inlet, 1 m^3/h	18/04/03	In	1														1
DPM100100 PP	Spare baffle plate for PM10 inlet	18/04/03	In	5														5
For all of the above monitors																		
002270100	Gasket window	27/11/02	In	60		24.10.2003	In	5			Out	3						62
011390200	Assembly, Power Supply Module 230V/50Hz,CE	18/04/03	In	2														2
012360000	Fan, Power Supply Module	18/04/03	In	2														2
014610000	Cooler Assembly	18/04/03	In	1			Out	1										0
FL0000001	Sintered Filter (002 - 024900)	27/11/02	In	18		24.10.2003	In	18			Out	6						30
FL0000003	Filter, DFU (036-040180)	27/11/02	In	5		24.10.2003	In	5										10
HE0000017	Heater, Reaction Cell, 12W					18/04/03	In	2										2
HW0000020	Spring, Flow Control	27/11/02	In	18		24.10.2003	In	18										36
OR0000001	O-Ring, Flow Control	27/11/02	In	36		24.10.2003	In	36										72
OR0000035	O-ring, Drier Column	27/11/02	In	20		24.10.2003	In	20										40
OR0000059	O-ring, Scrubber	27/11/02	In	20		24.10.2003	In	20										40
PS0000010	15V Switching Power Supply	18/04/03	In	2														2
PU0000020	Pump, 115V 50/60 Hz	18/04/03	In	1														1
PU0000022	Pump Rebuild Kit, KNF Model #N05ATI	27/11/02	In	8		18/04/03	In	1		24.10.2003	In	8			Out	8		9
Y-connector (l)	Y-connector (l)	27/11/02	In	12														12
	PTFE filters, 47mmØ					24.10.2003	In	700										700
	PTFE filters	27/11/02	In	700														700
Opsis DL 256 PRO Datalogger																		
	Fuse, 2,5A, Slow, 20 x 5 mm, each 10 pcs	24.10.2003	In	1			Out	1										0
	Fuse, 2A, Slow, 20 x 5 mm, each 10 pcs	24.10.2003	In	1			Out	1										0
Miscellaneous																		
	DIN 5, adapter gas regulator (already invoiced)	18/04/03	In	1			Out	1										0
	DIN 8, adapter gas regulator (already invoiced)	18/04/03	In	1			Out	1										0
SUM Trans																		

Appendix H4: Spare parts needed at DONRE, 27 November 2003

Spare parts List

Part number	Item	Qty			
		From NILU	**Need more**		
			Total	NILU	DANIDA
API Model 100A Spare Parts					
002620100	UV Lamp Assembly	1			
003290000	Thermistor Assembly 885-071600	0	**3**	1	2
004020300	Sensor Board	1			
013140100	Fan, PMT Cooler	1			
FM000004	Flow Meter, 0-1000 cc	1			
SW0000008	Pressure Sensor	1			
RL0000008	Solid State Relay, 12 Vdc	2			
KIT000093	CD, UV Filter 214 NM	1			
SW0000006	Overheat SW, Cell/Oven	1			
PU0000020	Pump, 115V 50/60Hz	1			
013400000	PMT, SO2		**3**	1	2
014610000	Cooler Assembly		**2**	1	1
002720000	PMT, Optical Filter (002-035300)		**5**	2	3
OP0000012	UV Detector		**3**	1	2
PS0000002	High Voltage Power Supply		**2**	1	1
013420000	Rotary Solenoid Assembly (Shutter Solenoid)		**3**	1	2
API Model 200A Spare Parts					
002730000	Window 665 NM (002-013100)	1	**2**	0	2
011310000	Drier Assembly Complete with Flow Control	1			
013140000	Fan, PMTCooler	1			
CB0000001	FUSE 03, 1A	1			
KIT000103	Replacement, Moly Guts, Lona, Type J (Guts only -TC, heater, cartridqe)	1			
PU0000006	Pump 220V/50Hz	1			
PU0000011	607 Pump Rebuild Kit	1			
004020200	Flow/Pressure Sensor Board		**1**	1	0
011330000	O3 Generator Assembly		**1**	1	0
011930000	PMT, NOx		**3**	1	2
014080100	Assembly High Voltage Power Supply		**2**	1	1
014610000	Cooler Assembly		**2**	1	1
011900000	37mm Sample Filter Assembly		**5**	2	3
015062300	NOx permeation tube		**6**	0	6
API Model 300 Spare Parts					
000941000	Orifice, 13 mil 1000 cc, Rx Cell	1			
005511400	Assembly, Power Supply Module 230V/50Hz,CE	1			
006110100	Assembly, Band Heater M300	1			
007930000	Assembly, Fan, PSM (FA0000004 ASSY)	1			
015810000	Source Assembly (with Adapter)	1	**2**	1	1
016910000	AKIT, Exp. Kit, CO Catalyst	1			
KIT000109	Replacement, Opto Sensor M300	1			
VA0000002	Solenoid, Stainless Steel, 24V	1			

Part number	Item	Qty			
		From NILU	Need more		
			Total	NILU	DANIDA
API Model 400A Spare Parts					
005260200	UV Lamp Assembly, Source	1			
006120200	Assembly, Ozone Generator Lamp w/ Piatail	1			
011390300	Assembly, Power Supply Module -230V/50 Hz, CE	1 (used)	**1**	1	0
024190000	Assy, Heater, Thermistor, UV Lamp, (M400A/M450)	1			
KIT000076	M400A Absorption Tube Replacement	1			
FL0000012	Filter,M400A Reference Scrubber	3			
FA0000010	Fan	1			
VA0000042	Valve, 3-Way, 1/8" tube	2			
015090000	UV Lamp Power Supply		**2**	1	1
API Model 701 Spare Parts					
014340000	Valve, Shuttle, Drier	1			
FA0000006	Fan,115Vac	1			
FL0000015	Filter, Air 150LPM, M701	1			
VA0000011	Valve, 4-Way, Drier	1			
VA0000014	Pressure Reaulator	1			
VA0000016	Valve, CHECK	1			
VA0000017	Valve, 2-Way (Water Drain)	1			
005960000	Activated Charcoal,6 lbs	15			
005970000	Purafil, 6 lbs., IZS OR Valve VER	15			
006900000	Charcoal Retainer Pads M100/M200	34			
006900100	Charcoal Retainer Pads M400	40			
016920000	Mol seive, 11ozs (CH033)	10			
FL0000016	Filter paper for FL 15 (Concumable - already invoiced)	10			
	Water drop out Filter		**1**	0	1
	Leak checker		**1**	0	1
	Flow meter (Omega)		**1**	0	1
Opsis DL 256 PRO Datalogger					
	Internal Modem		**5**	5	0
Gas Cylinder					
	NO		**5**	1	4
	SO2		**3**	0	3
	CO		**3**	0	3

Appendix H5: High priority list of spare parts

		Total	For station of	
API Model 100A Spare Parts			NILU	DANIDA
013420000	Rotary Solenoid Assembly (Shutter Solenoid)	**3**	1	2
002720000	PMT, Optical Filter (002-035300)	**5**	2	3
PS0000002	High Voltage Power Supply	**2**	1	1
003290000	Thermistor Assembly 885-071600	**3**	1	2
API Model 200A Spare Parts				
011930000	PMT, NOx	**3**	1	2
014080100	Assembly High Voltage Power Supply	**2**	1	1
011900000	37mm Sample Filter Assembly	**5**	2	3
API Model 701 Spare Parts				
	Water drop out Filter	**1**	0	1
Others				
	Leak checker	**1**	0	1
	Flow meter (Omega)	**1**	0	1
Opsis DL 256 PRO Datalogger				
	Internal Modem	**5**	5	0
	Connection board	**2**	2	

Appendix I

Task 9. Data interpretations

Appendix I1: Evaluation of Meteorological data

Memo

Title	Evaluation of Meteorological data
Purpose	To verify the quality of the measurements and evaluate the possibility of producing wind frequency distributions.
Distribution	Dr. Le Van Khoa (LVK), Mr. Vo Thanh Dam (VTD), Thanh Nguyen The (TNT), Rune Oedegaard (RuO), Rolf Dreiem (RD)
Author	Bjarne Sivertsen
Date	10 November 2003
Reference No	O-101143

Introduction

The meteorological data collected at the 30 m tower at Doste have not all been correct since the measurements started. Lacking of training in the interpretation of data as well as malfunctions in the sensors or in the calibration factors has lead to a database that presently only can partly be used.

The data have been commented in both Mission report 1 and 2. The data collected by the Gill sonic anemometer have never been entered into the database. These data experienced fatal errors already since October 2001.

Looking through the data it seemed that meteorological data have only been available till the end of May 2003. These data will be entered into AirQUIS for test and verification. The data quality from 1 January to 31 May 2003 has therefore been discussed below.

Temperature data

The temperature measurement at the top of the 30 m tower seem okay during the test period as shown in Figure 1.

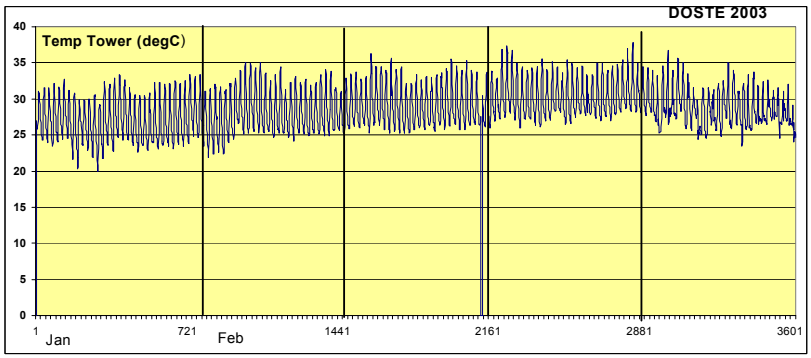


Figure 1: Temperatures measured at the top of the 30 m tower at DOSTE, Jan-May 2003.

To estimate the atmospheric stability using the temperature gradient, we will need the temperature at two levels. Temperature measurements are also performed at the shelter about 3 m above the surface. These data were also investigated. However, it can be seen in Figure 2 that this lower temperature had not been operating properly.

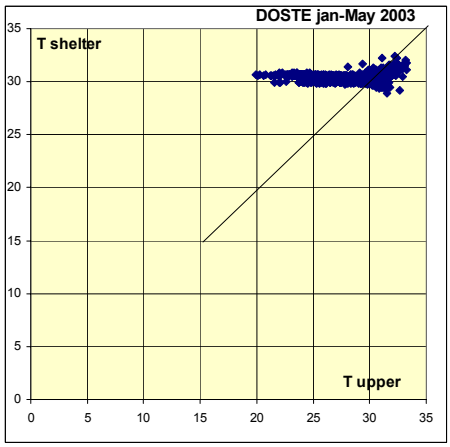


Figure 2: Simultaneous observations of temperatures at the shelter and the tower.

The temperatures at the top of the tower ranged between 20 and 33 degrees C, while the temperatures measured at the shelter were all between 29 and 32 degrees. These temperatures have to be disregarded as a basis for estimating the temperature gradient.

The temperature gradient has therefore been 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.

DelT= ((0,007 * H*(T+z*g/100))/u * z)-z*g/100

DelT = temperature difference between upper and lower level
H = Incoming radiation (W/m2) = F3
T = Temperature at top of tower (degC) =G3
g = adiabatic temp gradient = (1,05 – 0,005*RH) (empiric)
RH = relative humidity measured at tower (%)
u = wind speed at tower level (m/s) = E3
z = height of upper measurement (m) =30 m

DelT = 30*(1,05-0,005*F3)/100-((0,007*G3*(H3+(1,05-0,005*F3)/100))/(E3*30))

Wind data

Wind directions and wind speeds did not function until 9 January 2003. The wind direction data have shown major errors also in earlier analyses.

During the period Jan-May 2003 that wind directions seem relevant. The prevailing wind directions were from easterly and southeasterly directions. The record of wind directions for the whole period is presented in Figure 3, and an example wind rose is shown for January and April 2003 in Figure 4.

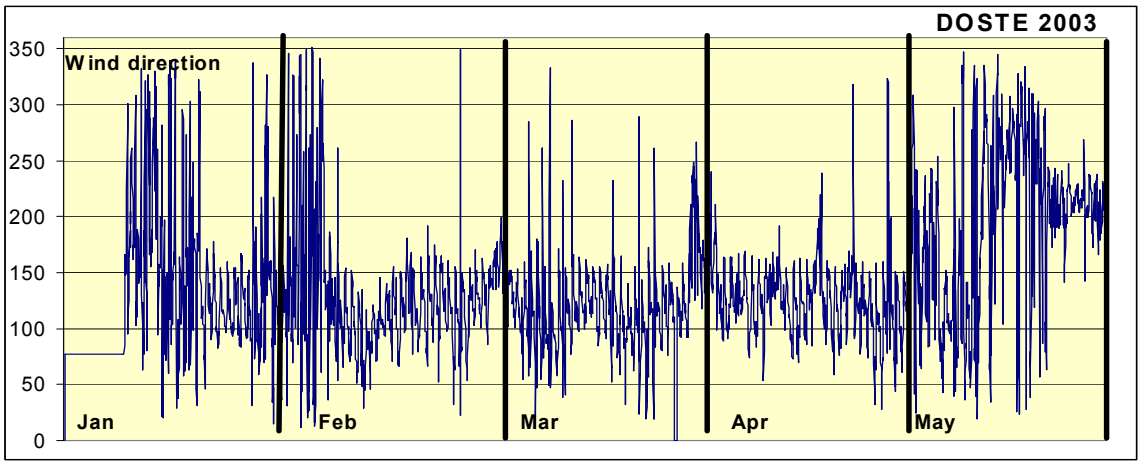


Figure 3: Wind direction records measured with the wind vane at the tower at Doste, January to May 2003.

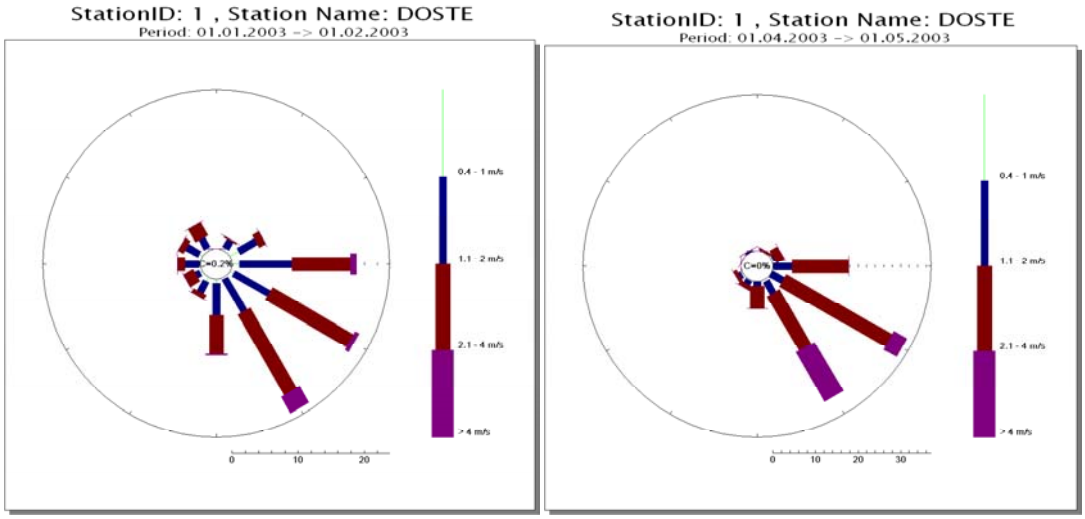


Figure 4: Wind roses generated for the months of January 2003 and April 2003, based on data from the wind vane at the Doste tower.

The prevailing winds as measured at the Doste tower is in accordance with the prevailing winds for this season as reported by the Meteorological Office ten year statistics, 1991-2000.

The wind speed data also seem to be relevant. All observations of wind speeds as a function of wind directions are presented in Figure 5 for the month of February 2003.

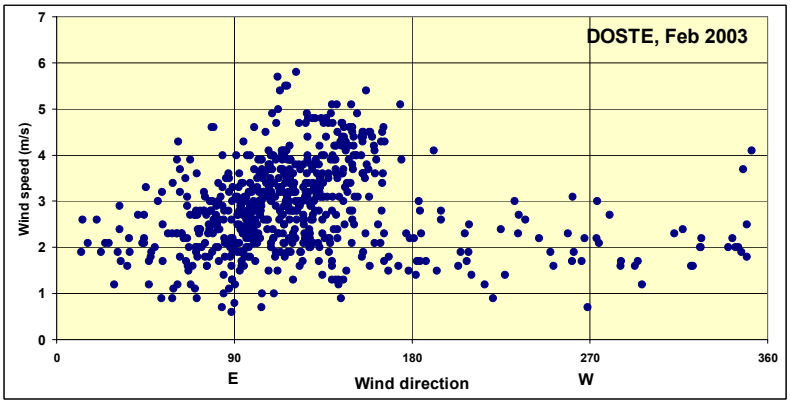


Figure 5: Records of wind speeds as functions of the wind directions at Doste tower, February 2003.

Figure 5 shows clearly the dominating frequency of winds from around southeast. Wind speeds above 4 m/s also occurred during these frequent wind directions.

Radiation data

The global radiation data during the test period January to May 2003 look okay. In Figure 6 we have selected two periods: 1-11 January and 17-31 May 2003.

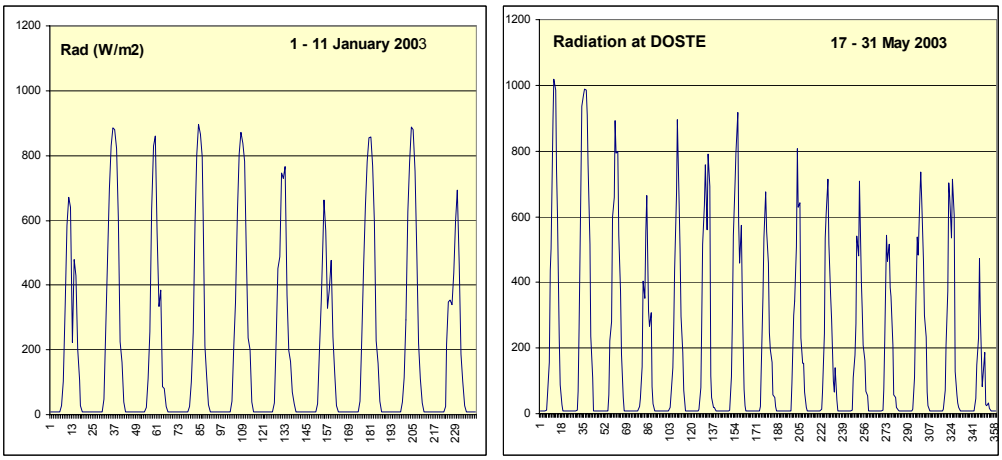


Figure 6: Radiation data from Doste during two periods; 1-11 January and 17-31 May 2003.

The maximum incoming solar radiation during daytime in January varied between 600 and 900 W/m2. At the end of May the radiation varied between 1000 and 500 W/m2. The reduction due to the beginning of the rainy season can clearly be seen in the data.

Appendix I2: Stability estimate – preliminary procedure

Memo

Title	Stability estimate – preliminary procedure
Purpose	Due to lack of temperature at two levels a stability parameter had to be produced from other data.
Distribution	Le Van Khoa (LVK), Vo Thanh Dam (VTD), Nguyen Bao Quoc (NBQ), Rune Oedegaard (RuO) and The Nguyen Thanh (TNT)
Author	Bjarne Sivertsen (BS)
Date	16 November 2003
Reference No	O-101143

Stability based on vertical temperature gradients

The temperature measurements at the lower level at DOSTE proved to be not functioning. The meteorological data were totally missing from 1 June 2003, with an exception for two weeks of data in September 2003.

To enable estimates of an atmospheric stability parameter we have used the Bulk Richardson number approach, where:

$RIB = ((g/\theta)*(\Delta\theta/\Delta z))/(\Delta u/\Delta z)**2 = - kk*H/(\Delta u)**3$

$\Delta\theta = prop-(H*\theta/(\Delta u* \Delta z) = \Delta T- \gamma$

H = heat flux = approximated proportional to measured radiation (W/m^2)
rad = incoming radiation (W/m^2)
$\Delta\theta$ = potential temp grad = $\Delta T- \gamma$
Δz = height difference between upper and lower temperature sensor (30m)
γ = adiabatic temp grad. = Approximated by (1,05-0,005RH) (deg/100m)
u = wind speed (m/s) at upper level assumed equal to Δu
RH = relative humidity
T = temperature (degC)
kk(i) = constant including density (ρ), gravity (g) and von Karman const. (k)

$\Delta T = \gamma - kk*H(T+ \gamma* \Delta z)/(\Delta u* \Delta z)$

The temperature gradient is thus approximated by the empirical expression:

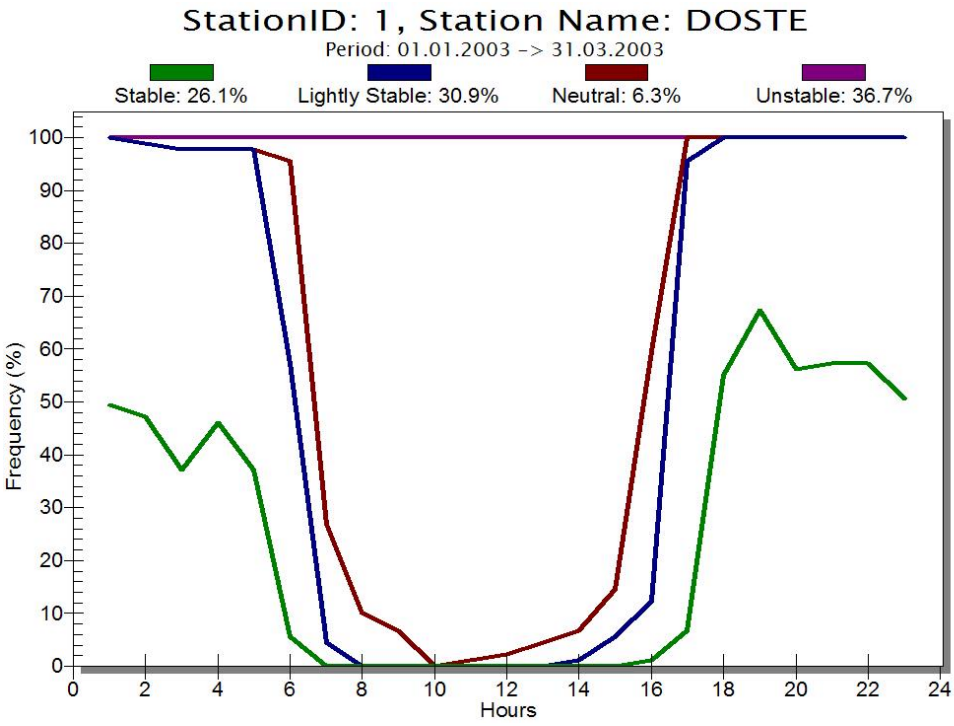
$\Delta T =(1.05-0.005*RH)-((0.007*rad*(T+30*(1.05-0.005*RH)/100)))/(u*30)$

The stability distribution based on this vertical temperature gradient between 30 m and 3 m has been estimated from AirQUIS statistics.

The following classes of stability were used:

- Very stable: dT > 0,2 deg
- Slight stable: 0<dT<0,2 deg
- Near neutral 0>dT>-0,2 deg
- Unstable dT<-0,2 deg

Based on data from 1 January 2003 to 31 March 2003 the following stability distribution can be found:



We see that the nights between 18:00 hrs to 06:00 hrs in the morning were very stable, while the daylight hours between about 09:00 hrs till 15:0 hrs were always unstable.

Appendix I3: Air Quality Index (AQI)

The Air Quality Index (AQI) will be estimated in AirQUIS based on the present air quality standards for Vietnam.

A summary of the Vietnam standard TCVN 5937 – 1995 is presented in Table 1:

Table 1 – Ambient air quality standards (all values are in mg/m^3)

No	Parameter	1 hr average	8 hr average	24 hr average
1	CO	40	10	5
2	NO_2	0.4	-	0.1
3	SO_2	0.5	-	0.3
4	Lead (particulate)	-	-	0.005
5	O_3	0.2	-	0.06
6	SPM (Suspended particulate matter)	0.3	-	0.2

There is no standard for PM_{10}. In our estimates for AQI we have used a value equal 0.5* S^d , which is the TSP or SPM concentration measured by high volume samplers (*See comment below*).

Comment:
Results have indicated that the ratio of PM10 to TSP at several monitoring stations in Asia is only slightly smaller than the average ratio occurring in the U.S. (0.53 compared to 0.55 in U.S. cities). Even after converting the mean TSP value of 378 μg/m^3 to PM10 using the local ratio to account for the slight difference in particle size, it was reported from an Indian study that PM10 over the four-year period reached 200 μg/m^3. Other data have indicated PM_{10} to TSP ratios from 0,3 to 0,6.

The measured results for the potential harmful species NO_2, CO, SO_2, O_3 and PM_{10} are included for determination of the AQI. (All parameters may not be measured at a given station. In this case only the measured parameters are included.) Further both hourly and daily averages are included to take into account that the health deterioration may be initiated both of short time exposure to high concentrations and long time exposure to lower levels. This fact is also reflected in the Air Quality Standards.

The simplest way to estimate the AQI for HCMC is dividing the procedures into hourly AQI(h) based on hourly concentrations and 1-hr average standards, and daily AQI(d) based on daily average concentrations and 24-hr average standards. The final AQI for each day will be the highest value of the hourly maximum AQI value and the daily AQI.

In the analyses below we have used the following nomenclatures:

h = hour j = site i = compound d = daily (24 hour) C = concentration S = standard (hourly, daily, annual)	Sites: 1 = DOSTE 2 = Hong Bang 3 = Tan Son Hoa 4 = Thu Duc 7 = District 1 Zoo 9 = Quang Trung Software City 8 = District 2 PC 5 = Thong Nat Hospital 6 = Binh Chanh Educ Centre

Hourly Index, AQI(h)

The highest ratio of concentration to standard for any site and compound during this hour is being estimated from:

$AQI(h,j) = Max_h\ (C(h,i,j)/S(h,i))*100$

The compound giving the highest ratio will give one index for each site for a given hour.

Daily Index, AQI(d)

A daily index is also established for the compounds available at each station, such a SO_2, NO_2, CO, O3 and PM_{10}. The procedure is similar to the hourly giving:

$AQI(d,j) = Max\ (C(d,i,j)/S(d,i,))*100$

The daily air quality index will be selected as the higher of the two indexes:

Max((AQI(h,j),AQI(d,j))

The index for one site will thus be related to the compound that gives the highest ratio of the highest hourly and the 24-hour average concentration to standard.

Site type relevant hourly index

Based on a total of 9 stations in operation in HCMC, the index will be divided in two categories;

- **Traffic** represented by the DOSTE, Hong Bang, Thong Nat Hospital and Binh Chanh Educational Centre.
- **Urban residential** represented by the Tan San Hoa, District 1 (Zoo) and Quang Trung Software City.

The remaining stations at Thu Duc and District 2 PC are located in residential areas highly impacted by industrial sources. These data will be presented in the monthly reports by different type of statistics.

The two types of Air Quality Indexes (AQI) is therefore:
Traffic:
AQI(traffic) = (AQI(1)+AQI(2)+AQI(5)+AQI(6))/4
Urban/residential:
AQI(urban/residential) = (AQI(4)+AQI(7)+AQI(9))/3
A third AQI (**residential/industrial**) may be generated from (AQI(4)+AQI(7))/2

Categorised air quality

The air quality is categorized in five classes, based on the guidelines given in the US Federal Register Part III, Environmental Protection Agency, 40 CFR Part 58, according to the following table:

Classification of index	
0 to 50	Good
51 to 100	Moderate
101 to 200	Poor
201 to 300	Unhealthy
301 and above	Hazardous

AQI automatically generated by AirQUIS

AQI is generated from AirQUIS entered through the measurement menu. Every day at 08:00 hrs (time may be specified) the daily AQI will be updated. The air Quality will be classified according to AQI classes presented above. The classification may be altered if necessary. New sites and components may also be changed in the AQI generation.

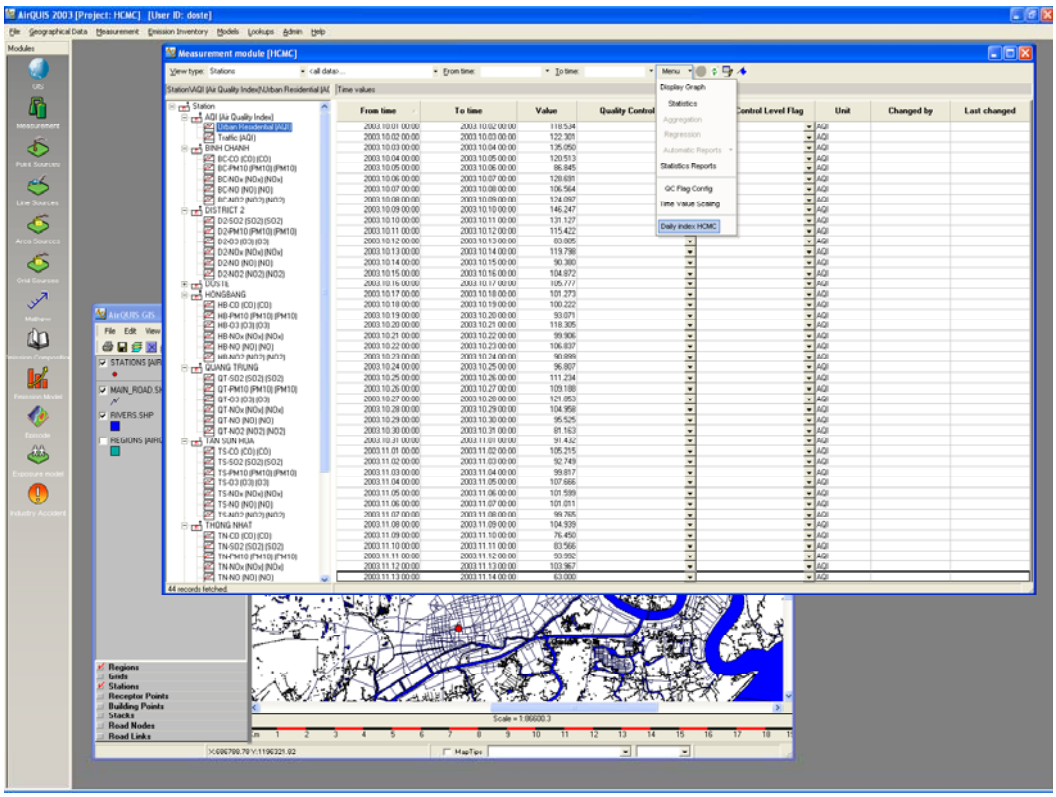


Figure 1: AirQUIS screen for entering AQI

The daily AQI will be updated in the graph (bottom right figure 2) automatically every day. The real-time window will continuously show the last 30 days AQI values. Previous data may be found in the AirQUIS database for statistical evaluation

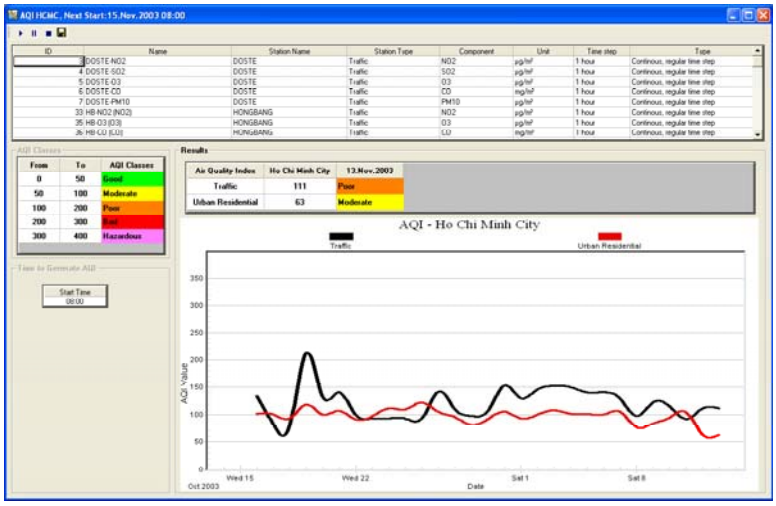


Figure 2: AQI output figures from AirQUIS.

Data quality assumptions:

To assure that adequate data quality has been taken into account in the generation of an AQI, the following quality assurance has been considered:

- Data with *warning and exclude flags* will not be part of the AQI estimate.
- Negative concentrations are not included.
- At least 6 one-hour average concentrations are needed to produce a daily AQI.

Exclude flags include:

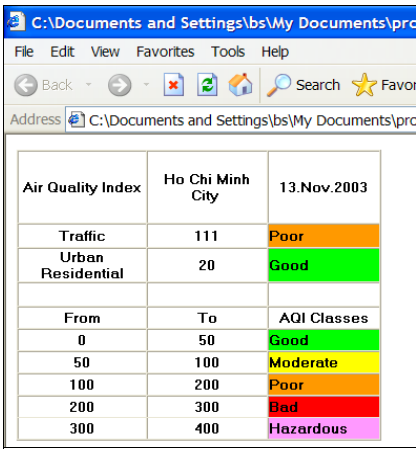
- Missing data
- Too many equal values after each other (presently set at 3 values)

Warning flags:

- Related to expected minimum and maximum values

AQI on HTML

As soon as the AQI value has been estimated for the preceding day a HTML page will be generated, which may be used to present the Air Quality Index for HCMC on Internet.



Air Quality Index	Ho Chi Minh City	13.Nov.2003
Traffic	111	Poor
Urban Residential	20	Good
From	To	AQI Classes
0	50	Good
50	100	Moderate
100	200	Poor
200	300	Bad
300	400	Hazardous

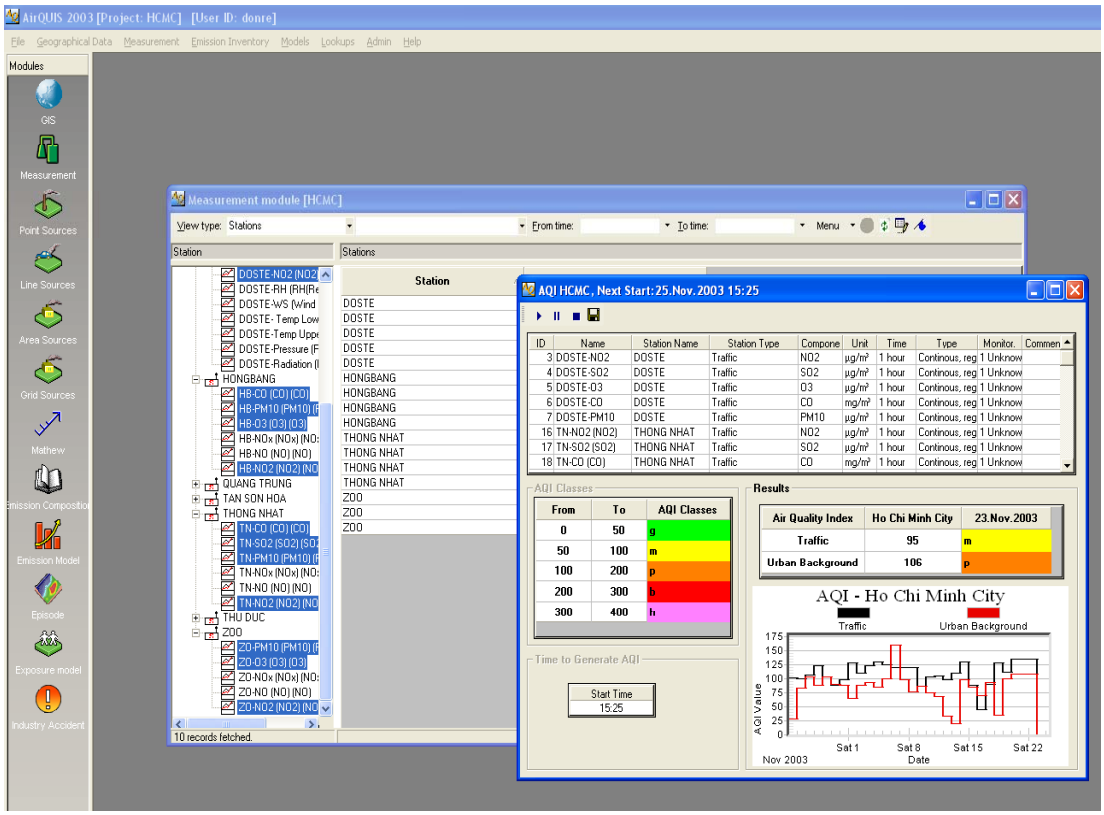
The final evaluation of the automatic AQI generator in AirQUIS will be undertaken in the near future, through testing and application. Verifications and testing will lead to a final version to be issued during the next few months.

Appendix I4: Testing AQI procedures

The daily Air Quality Index (AQI) is from 16 November 2003 automatically generated by the AirQUIS system. The procedures will be tested and verified during the next weeks.

One early deficiency that was identified on 23 November was due to completely missing data from one of the stations that generated the traffic AQI. The automatic version of the AQI generator would not produce a reasonable value.

As seen from the figure below, which show the AirQUIS screen dump of the AQI procedure, the AQI value comes out perfect if we only include the stations with valid data.

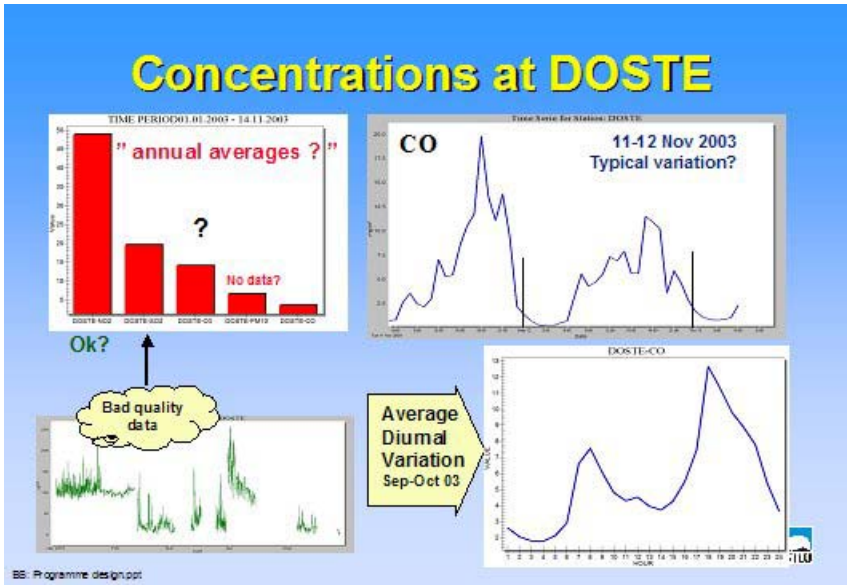


This deficiency will be looked into and corrected in the very near future.

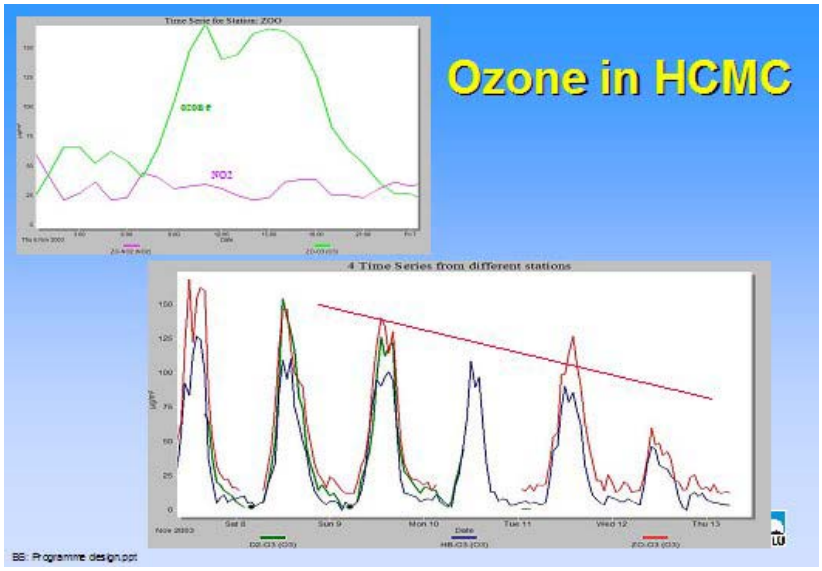
Appendix J
Task 10. Air Quality Assessment

Appendix J1: Air Quality Assessment

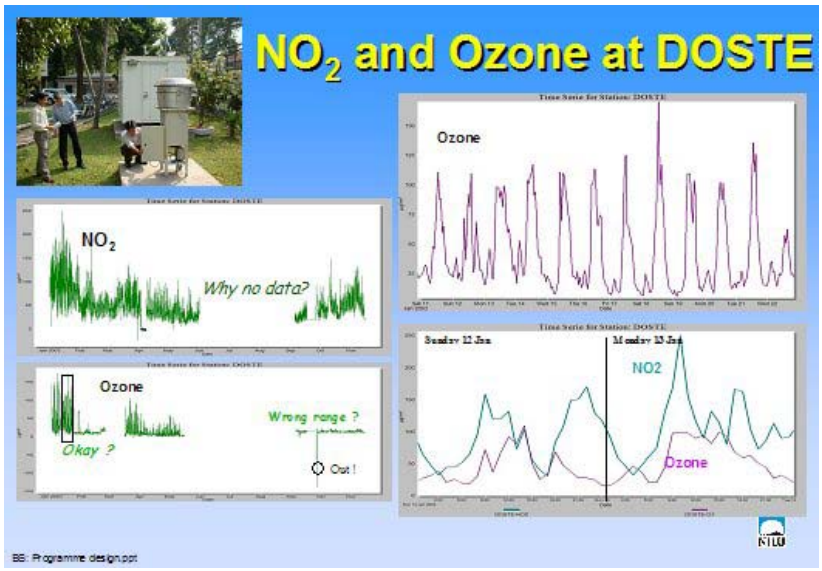
The following figures were presented in the workshop to illustrate some of the air quality data, and to discuss the assessment of air quality in HCMC.



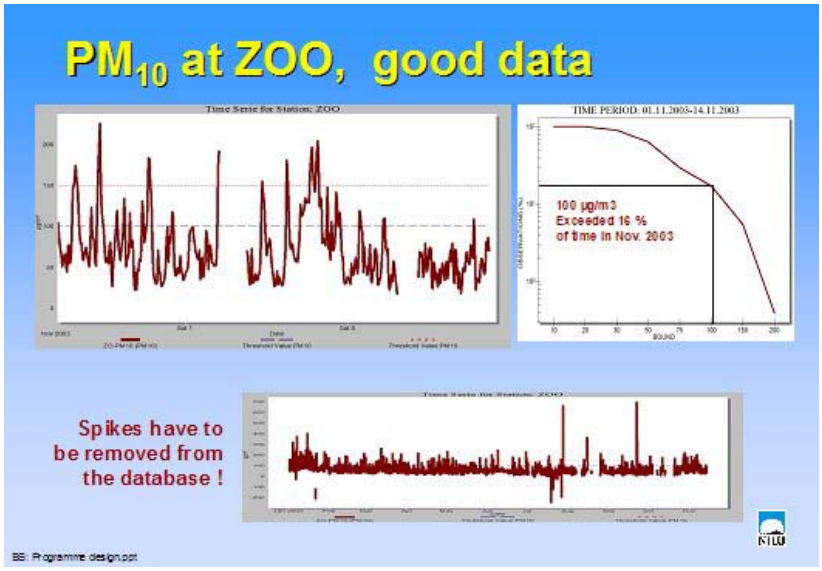
From "annual averages" we see that SO_2 data are of very bad quality. CO concentrations seem to be adequate, and show clearly peak values during rush hours in the morning and in the afternoon. The afternoon high peak is linked to the permission of large trucks and buses to use the street.



Ozone concentrations show a typical diurnal variation at all sites.



NO_2 and ozone at DOSTE worked properly for a short period in January 2003. The present ozone measurements show a range, which is too small. The instrument must be calibrated.



PM_{10} at ZOO seem to be of good quality.

Appendix K

Task 11. Capacity building

Appendix K: AirQUIS$_{2003}$ training April 2003

The Time schedule

Date		Topic	Responsible
Monday 31 Mar 2003	AM	Introduction to NILU Presentation of workshop program Guiding to NILU	B. Sivertsen/ T.N. Thanh
	PM	Introduction to AirQUIS (DEMO) • Navigation through the system	H. Laupsa
Tuesday 1 April	AM	AirQUIS - Geographical Information System (GIS)	H. Laupsa
	PM	AirQUIS hands-on training • GIS	H. Laupsa
Wednesday 2 April	AM	Introduction to Air quality models Abatement strategy planning	B. Sivertsen/T. Bøhler S. Larssen
	PM	QA/QC in measurements PM_{10} measurements	L. Marsteen R. Dreiem
Thursday 3 April	AM	AirQUIS - Measurement module	M. Johnsrud
	PM	AirQUIS -Automatic data import	T.N. Thanh
		AirQUIS - Statistics and reporting	M. Johnsrud
		AirQUIS hands-on training • Measurement module	M. Johnsrud
Friday 4 April	AM	AirQUIS hands-on training (cont.) • Measurement module	M. Johnsrud
	PM	Demonstration of Internet applications at NILU - Discussions	G. Endregard/B. Sivertsen/T.N. Thanh
Sat - Sun		Sightseeing	TNT/BS
Monday 7 April	AM	AirQUIS - Introduction to emission inventories module	H. Laupsa
	PM	AirQUIS hands-on training Emission inventories	
Tuesday 8 April	AM	AirQUIS – Emission inventory templates and data collection	H. Laupsa (R. Ødegård)
		Mr Khoa visit to SFT	
	PM	AirQUIS – Emission inventory- build a database	B. Sivertsen H. Laupsa (R. Ødegård)

The training programme

Day 1: Monday 31 March

Introduction and demonstration of AirQUIS$_{2003}$

Introduction

- Presentation and aim of the training

Description of AirQUIS

- Concept of AirQUIS 2003

- Technical description of AirQUIS
- AirQUIS user interface
- AirQUIS projects

DEMO of Geographical Information System (GIS)

- Concept of the GIS

- Presentation of data by using GIS
- Searching the database through GIS
- Entering and editing data through GIS

DEMO of Measurement module

- Concept of the measurement module

- Lookups
- Time series
- Graphical presentations
- Data statistics:
  - Statistics
  - Special calculations
- Reports
  - Statistics
  - Automatic
- Flags
  - QA
  - QC
- Import
  - Manual import
  - Automatic import

DEMO of Emission inventory module

- Concept of the emission inventory module

- Emission inventory Lookups
  - Fuel
  - Raw material
  - Product
  - Source sectors

  - Time variation
- Point emission
  - Industry
  - Stack
  - Cleaning device
  - Process
  - Process data
  - Emission factors
- Line emission
  - Road nodes
  - Line sources
  - Road class
  - Vehicle class
  - Traffic emission factors
- Area emission
  - Area sources
  - Area emission factors
  - Temperature correction data
- Emission summary report

DEMO of Models module

- Concept of the AQ-models

- Meteorology model
  - Metrology composition
  - Mathew calculation
  - Mathew results
- Emission model
  - Emission composition
  - Emission calculation
  - Emission results
- Dispersion model
  - EPISODE -industry accident model
  - EPISODE- model
  - EPISODE- results
- Exposure model
  - Exposure model
  - Exposure results

DEMO of Geographical module

- Concept of the geographical module

- Region levels
- Region
- Grid
- Topography
- Population data
- Receptor point
- Building points

Data import and data export

- Import templates
- Import wizard
- Import templates

The data set type

- Region data set (input: population, topography, emission, consumption data)
- Field Data (input: population, emission, topography, output: model results)
- Building point dataset (input: population data in buildings, output: model results)
- Receptor point data set (output: model results)
- Stack data set (output: emission model results)
- Line Data Set (output: model results)

Data type

- Mathew
- Emission
- EPISODE
- Exposure

AirQUIS ADMIN module

- Concept of the ADMIN module

Hands on training

- Navigation through the system

Short summary of the day

Day 2: Tuesday 1 April

Geographical Information System (GIS)

Introduction to GIS

- Concept of the Geographical Information System

- AirQUIS themes
- Shape themes

- Presentation of data by using GIS
- Searching the database through GIS
- Entering and editing data through GIS

- Maps and GIS
- Regions and region levels

Hands- on training GIS

AirQUIS ADMIN module

- Concept of the ADMIN module

- Project manager
- Change language
- Logging

Hands- on training ADMIN module

Short summary of the day

Day 3: Wednesday 2. April

Lectures and training:

- Modelling
- Abatement strategy planning
- QA/QC
- Eberline PM_{10} monitor

Day 4: Thursday 3 April

Measurement module and automatic data import

- General on database structure
- Preparation of input data
- Import lookup tables
- Import stations and time series, import data
- Hands on training on data import
- Automatic data import

Hands- on training - measurement module

Short summary of the day

Day 5: Friday 4 April

Measurement module and Internet application

Hands-on training - measurement module

- Data retrieval and filters
- Graphs and statistics
- Hands on training on graphs and statistics
- Use of flags in graphs and statistical calculations
- Meteorology calculations
- Automatic reports

Internet application

Day 6: Monday 7. April

AirQUIS - Introduction to emission inventories module and emission inventory templates and data collection

Introduction to the AirQUIS emission inventory database

- Concept of the emission inventory module

- Lookups
- Area-, line- and point sources
- Consumption, emission and production data

Emission inventory Lookups

- Source sectors
- Fuel
- Raw material
- Product
- Time variation

Point sources

- Industries
- Stacks
- Cleaning device
- Processes
- Process data (Emission/Consumption/production data)
- Emission factors

Line sources

- Static data
  - Geography (road nodes, length, with, gradient, directions)
  - Lookups (Road class)
- Dynamic traffic data (ADT, speed, VP)
- Emission factors and dependencies
  - General lookups
    - Fuels
  - Special lookups
    - RVC
    - ECVC
  - Emission factors
    - ECVC – RVC Distribution
    - ECVC Fuel Consumption
    - ECVC Basic and Ageing Factors
    - ECVC Speed Dependency Factors
    - ECVC Road Gradient Factors
    - ECVC NO2 percentage in NOx
    - Percentage of Studded Tyre

Area sources

- General lookups
  - Source categories
  - Fuels
  - Time variations

- Special lookups
  - Emission factors
  - Temperature correction data

- Regionally or gridded distributed consumption/emission data

Emission inventory templates and data collection

- General lookup data
- Emission inventory lookups
- Emission inventory point sources
- Emission inventory line sources
- Emission inventory area sources
- Traffic emission factors

Short summary of the day

Day 6: Tuesday 8 April

How to build an emission inventory database and Introduction to admin module, general lookups and geographical data

How to build an emission inventory database

- Introduction
- Import templates (IDS)
- Order of importing data
- Backup (database dumps)

General lookups and general predefined data

- Medium
- Components
- Validity Period
- Unit and unit types
- Data type

Geographical data

- Concept of the geographical data

- Grid
- Topography
- Population data
- Receptor point
- Building points

Hands- on training emission inventory module

Introduction to AirQUIS Models

- Concept of the AirQUIS models

- Meteorology model
  - Metrology composition
  - Mathew calculation
  - Mathew results
- Emission model
  - Emission composition
  - Emission calculation

  - Emission results
- Dispersion model
  - EPISODE -industry accident model
  - EPISODE- model
    - Emission data
    - Meteorological data
    - Background concentrations
    - Storing results
    - Other input data
  - EPISODE- results
- Exposure model
  - Exposure model
  - Exposure results

Short summary of the day

Day 6: Wednesday 9 April

AirQUIS – introduction to AQ – models

Introduction to AirQUIS models (cont.)

- Presentation of model results by using GIS

Hands- on training models

- Run AirQUIS models
- Model presentation

Short summary of the day

Day 6: Thursday 10 April

Application of the total AQ system and summary of AQ training

Hands- on training -Use of the total system

Summarise of AirQUIS applications

Questions and answers

Short summary of the day

Norwegian Institute for Air Research (NILU)

P.O. Box 100, N-2027 Kjeller, Norway

REPORT SERIES	REPORT NO. NILU OR 84/2003	ISBN 82-425-1521-2	
SCIENTIFIC REPORT		ISSN 0807-7207	
DATE	SIGN.	NO. OF PAGES	PRICE
		126	NOK 150,-

TITLE	PROJECT LEADER
Ho Chi Minh City Environmental Improvement Project Air Quality Monitoring Component Mission 3, November 2003; Status report (QR6), AirQUIS installed and trained	Bjarne Sivertsen NILU PROJECT NO. O-101143
AUTHOR(S) Bjarne Sivertsen, Rolf Dreiem and The N. Thanh	CLASSIFICATION * A CONTRACT REF.

REPORT PREPARED FOR
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ABSTRACT

The Ho Chi Minh City Environmental Improvement Project, Air Quality Monitoring component (HEIA) is being supported by NORAD and is being undertaken by NILU for the Department of Natural Resources and Environment (DONRE). The third Mission to Ho Chi Minh City had several objectives. The main task was to install the GIS based database and planning system AirQUIS, perform training and prepare input data for modelling. The mission also included development of e new Air Quality Index procedure and data reporting. A workshop was prepared to discuss meteorology and air quality data assessment.

NORWEGIAN TITLE

KEYWORDS		
Air quality monitoring	Air quality assessment	Vietnam

ABSTRACT (in Norwegian)

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