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 4, April 2004; Status report (QR7-9), Data assessment and training

NILU
Norwegian Institute for Air Research

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

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List of Abbreviations

ADACS	Automatic Data Acquisition System
AQI	Air Quality Index
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 DONRE
EPU	Environmental Protection Unit
GIS	Geographical Information System
HCMC	Ho Chi Minh City
HEIA	HCMC **E**nvironmental **I**mprovement Project **A**ir Quality Monitoring component
HEIP	HCMC **E**nvironmental **I**mprovement Project
ISO	International Organization for Standardization
NEA	National Environmental Agency
NILU	Norwegian Institute for Air Research
NO_2	Nitrogen dioxide
NORAD	Norwegian Agency for Development Cooperation
MPI	Ministry of Planning and Investment
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

1 Task 1. The AQ system for HCMC

1.1 Introduction

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

The Executing Agency for the **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 now been established and is being operated by trained DONRE experts. During the last year DONRE has received training and is operating both the measurements as well as the air quality management system AirQUIS. Mission 4 to HCMC was undertaken from 14 to 23 April 2004, and included:

- Further training in the use of AirQUIS models
- Import air quality and meteorological data
- Test and verify the Air Quality Index procedures
- Continue collecting emission data for modelling purposes
- Test emission data and model test results
- Plan and assess further training needs
- Prepare schedules for the development of a Reference Laboratory
- Perform on-the-job training.

The daily schedule for Mission 4 is presented in Appendix A1.

1.2 Administrative meetings

Several meetings were organised at DONRE during Mission 4. (See Schedule presented in Appendix A1). The results of these meetings may be found in the appendices as Minutes from the meetings or in various memos. Project meeting have also been held at NILU.

1.2.1 Project meetings

Project meetings have been held at NILU to follow-up the project. Minutes from some of these have been sent to DONRE. A summary of the training workshops given for the application of AirQUIS models has also been reported (Appendix G1). The results of one meeting in March have been presented in Appendix A2.

1.2.2 Meeting at DONRE head office

On 23 April 2004 we met with the Deputy Director Mr. Nguyen Van Chien. The group working with the HEIA air quality project is about to move to a new centre, which will be established within the next two months. This Environmental Protection Unit (EPU) will consist of 5 sub divisions. The existing air quality monitoring programme for HCMC will be part of the monitoring and evaluation division.

In the meeting with Mr. Chien we presented the project, discusses the operations of the monitoring programme and elaborated on some key issues of specific interest to the benefit of the project.

A memo on a sustainable air quality monitoring programme for the future had been developed as presented in Appendix A5. This memo roughly evaluates the annual cost for operation and maintenance of the air quality monitoring programme for HCMC such as designed during the DANIDA/NORAD development.

To continue operating this programme as to day with adequate quality and confidence will require that:

- Experts that have received training stay with the future programme (new Centre)
- Instruments, databases and equipment are kept updated and in good quality
- Spare parts and consumables are made available in good time before needed
- Quality assurance programmes are kept at the level originally established.

The contents and significance of the limited funds were discussed, and the possibilities for future co-operation were briefly communicated.

1.2.3 Possible future co-operation

DONRE (the new Centre) and NILU is planning to prepare a future co-operation using the air quality expertise established at DONRE as the basis for offering and providing

air pollution services in the future. These services will include Measurements, Emission inventories, Air Pollution Modelling, Air Pollution Management, Air Quality Impact Assessment, Air Quality Abatement Strategy Planning and Internet presentations. Services may be offered to National and International Agencies, Industries, Consultants and others.

1.3 Additions to the project

NORAD has confirmed that 1,7 mill NOK will be supported to the project for establishments of a Reference Laboratory including maintenance and repair capacity building, plus additional training for the application of the AirQUIS system for air quality planning in HCMC. (See Appendix A3).

In a letter to SFT/NORAD it was stated that the main objectives were to improve the institutional capacity at DONRE. 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
- 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 about 1,7 million NOK. For further details see Appendix A4.

2 Task 2. Design and update

2.1 Monitoring sites operated

The air quality monitoring network in HCMC is now being operated adequately. The stations and site characteristics is given in the Table below.

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

0
Some connection problems with transferring data from stations to Environmental Data Centre (EDC) at DONRE due to poor telephone line or defect modem after storm have been identified. Based on the Audit performed on 20 April 2004 (See Appendix E1) the monitoring network is working adequately.

The data availability as well as the data quality seems to meet the standards set for such networks. However, there are some modifications and improvements still to be undertaken.

The monitoring network is presented in Appendix B1.

3 Task 3. Procure and install

3.1 Specifications

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

As a result of the development of a Reference Laboratory at DONRE NILU will prepare a list of specifications, which will be used for the purchase of necessary equipment. (See Appendix A3).

Additional spare parts specified by DONRE was delivered on 16 April 2004 as presented in Appendix C1

3.2 AirQUIS installations

Installations of AirQUIS at DONRE 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.

Some improvements and modifications have been implemented between November 2003 and April 2004. During Mission 4 the AirQUIS system was working very well.

4 Task 4. Assure system integration

4.1 Evaluate OPSIS system and improve routines

The existing data retrieval system is supported by the previous DANIDA project. The new project supported by NORAD is using the same data retrieval equipment and software as required by DONRE.

The existing OPSIS data retrieval system consists of

- OPSIS data logger for logging measurements from the monitors at the stations
- ENVIMAN Comvisioner for retrieving and presenting data from the stations to DONRE through modem communication

DONRE collects data from all the measurement stations once a day by using the existing OPSIS data retrieval system.

During the previous project, supported by DANIDA, the daily Air Quality Index (AQI) was produced by a simple software solution. The procedures used the Pascal programming tool and Excel for estimating AQI. This was a manual operation using Excel macro and a Pascal developed software. The routine for producing the daily AQI was not satisfactory and DONRE expressed the need for reducing the manual work for generating the daily AQI values.

The OPSIS ENVIMAN Comvisioner is running well. NILU has extended the existing data retrieval system for 5 new measurement stations supported by NORAD by procuring 5 additional ENVIMAN Comvisioner licenses.

One of the main challenges for daily retrieval of data is the frequently power cuts or heavy rains which have lead to missing data or/and defect equipments.

4.2 Integrating the existing data retrieval system into AirQUIS

The goal of this activity is to establish an integrated system for DONRE assuring that measurement data are automatically entered into the AirQUIS database.

The integration activity consists of the following work:

- Identify the existing routines at DONRE
- Analyse the existing routines to identify possible improvements before developing a integrated solution
- Develop an integration interface between ENVIMAN Comvisioner and AirQUIS for importing measurement data (Import module)
- Develop an automatic time scheduler for the import module
- Develop an automatic module for producing daily AQI

The new automatic import module and the automatic AQI routine have been tested and accepted by DONRE. The new automatic import module is now in production at DONRE and the new automatic AQI routine has replaced the existing one. New features regarding flexibility and user friendliness for the automatic daily AQI module have also been developed for DONRE needs.

The figure below show an example of the AQI produced by the automatic system using AirQUIS as the automatic generating tool. The Figure shows the daily AQI for traffic and urban background environments in HCMC from 25 March to 22 April 2004.

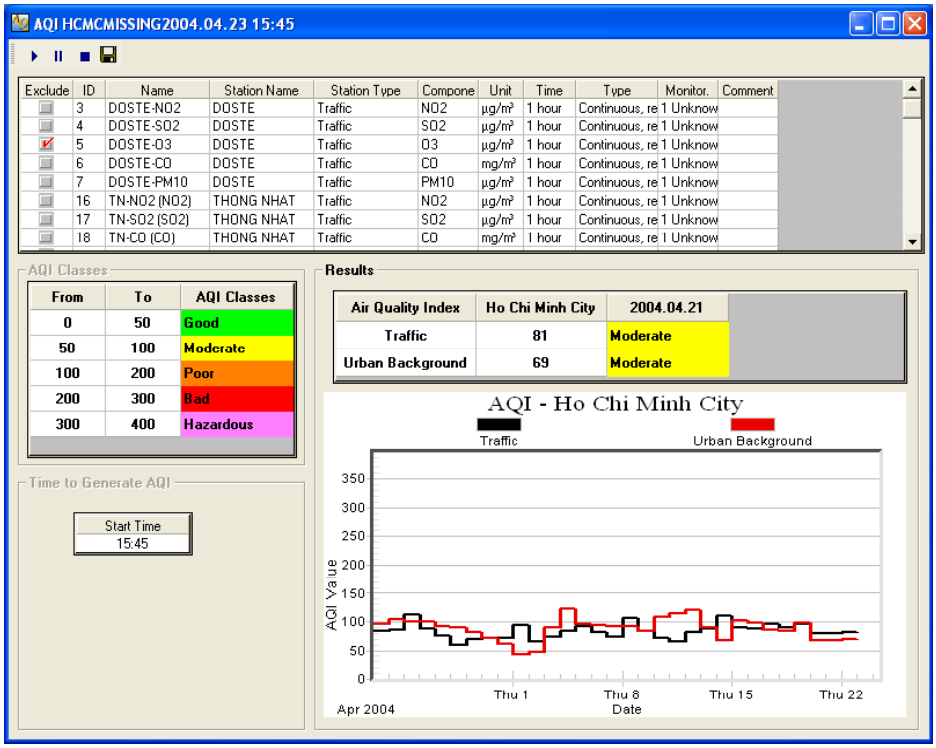

Figure 4.2: The automatic generation of daily air quality index, AQI, as presented from 22 March to 22 April 2004.

5 Task 5. Quality Assurance (QA/QC)

5.1 Design QA/QC and documentation materials

A total Quality Assurance and Quality Control (QA/QC) 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. Also other modifications have been introduced and presented to DONRE experts.

Standard Operating Procedures (SOPs) have been prepared for DONRE including station manuals for instrument installations, maintenance, controls etc. At each of the monitoring site a station history logbook is available.

All these procedures were established in November 2002, and it seems that the staff and operators at DONRE are presently following them. Some upgrading and repetition of the requirements seem, however, necessary.

5.2 Quality control at data retrieval

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

5.3 QA/QC training

Some QA/QC training has been undertaken as on-the-job training in HCMC and in a workshop at NILU. As part of the establishment of the Reference Laboratory at DONRE more detailed training will be performed. NILU will design and perform this training in the form of another workshop.

The QA/QC officer, who has been appointed by DONRE, Mr. Vo Thanh Dam, is the main responsible for the Quality Assurance programme developed for the air quality monitoring programme in HCMC.

5.4 Station Audit descriptions

A station audit was originally planned for Mission 4. Mr Rolf Dreiem is the instrument expert, and he would go through all the stations, instruments and identify the quality of the follow-up programmes and the QA/QC procedures.

Due to a heart attack Rolf will not be able to work until after the summer. The HEIA NILU project manager therefore undertook the Audit based on somewhat simplified procedures. The basic background was the general description of the contents of an audit.

The simplified audit included several controls such as:

- The station itself (infrastructures)
- Instrument performance including
  - Performance evaluation audit - gas monitors
  - Performance evaluation audit - PM_{10} monitors
  - Performance evaluation audit - High volume samplers
  - Evaluation of Meteorological equipment
- Documents and operational reporting procedures

More details are presented in Appendix E1. The audit was performed on 20 April 2004, and the Audit Report can be seen in Appendix H1.

The quality of the meteorological data was discussed in Appendix I1 of the Mission 3 report. Some errors have been identified in the wind direction sensors. Further audit to the meteorological tower was not undertaken. Some of the sensors may have to be changed in the near future.

6 Task 6. Install AirQUIS

6.1 Prepare AirQUIS platform and GIS

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

An updated status of the system operations is presented in Appendix F1.

6.2 Establish final GIS

The final GIS system for HCMC has been implemented and tested. The following status concerning the mapping of HCMC in the AirQUIS GIS system can be summarised:

- Administrative regions for HCMC are completed.
- Measurement station sites are completed.
- Stack coordinates are under verification.
- Road Nodes and Road links are still under updating.
- Grid: 40EW and 35NS with 1km resolution.
- Additional shape file for river is completed.

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

6.3 Develop and test interface

The running AirQUIS version at DONRE now is #371. The GIS system is described above. The following modules have been tested and accepted by DONRE:

Measurement
Nine stations with 65 time series are daily being quality controlled by DONRE. All data from the ENVIMAN database have been imported into AirQUIS.

Automatic import module
The automatic import module is now in operation at DONRE.

AQI
The daily AQI is calculated automatically by using the measurement data in AirQUIS.

Emission Inventory
This module has been tested and verified with the input data described in Chapter 7.2.

Dispersion Model
The meteorological data such as wind direction, wind speed, relative humidity, lower temperature and upper temperature from the DOSTE station have been entered into AirQUIS for the MATHEW wind field model.

DONRE has tested the dispersion model with selected stacks (point sources) and roads (line sources). Area source data has not been prepared yet.

New AirQUIS releases
NILU is continuing to improve AirQUIS and new releases of AirQUIS will be available for DONRE free of charge during the HEIA project period ending in 2005.

7 Task 7. Air Quality Modelling

7.1 Prepare input data

Preparations of input data to the models are under way. Based on specifications and templates given to DONRE during previous missions and as part of the model training sessions, DONRE experts are now collecting the data input needed.

A major part of this work is linked to obtaining emission data. Training in air pollution modelling, including preparation of input data, was given at NILU. A memo summarising this training period is presented in Appendix G1.

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. The collection of traffic emission data started after Mission 3.

The status of the emission inventory work using the templates from AirQUIS and the methodology given by NILU is presented in the following.

7.2.1 Point sources

A total of 35 industries with coordinates have been collected. 45 stacks have been identified with 30 processes together with consumption data given as ton per year. 12 more stacks are under verification. The fuels included are: fuel oil, coal and diesel heavy oil.

Another 13 remaining stacks are presently being verified. The validity period is 2003. Most of the source sectors for the emissions are from production processes, combustion in from manufactory production and solvent and other product use.

Critical success factors
It is very difficult to collect all the parameters required for running the models in AirQUIS because most of the industries cannot provide this kind of basic input data.

The time variation and the percentage of the sulphur content for the oil used are normally not known. NILU has assisted DONRE with the emission factors.

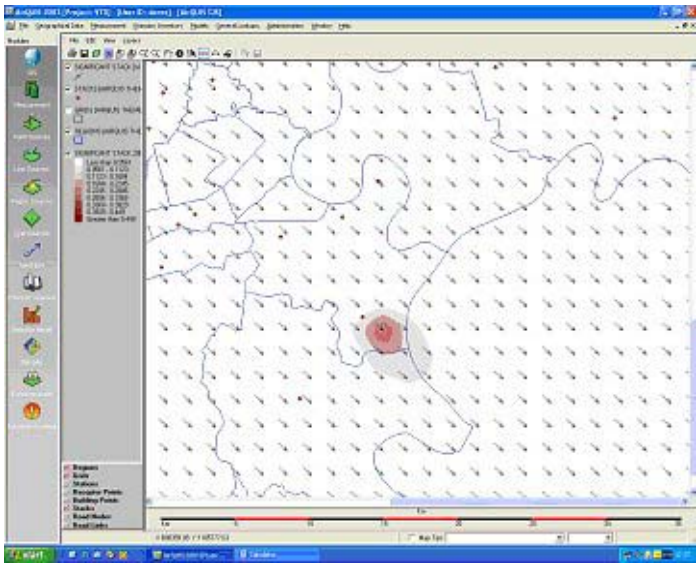

Figure 7.2: A test of the 1-hour average ground level concentration of SO_2 estimated based on emissions from one selected point source.

Remaining activities
The sulphur content for the oil will be investigated by DONRE. More processes will be identified. Some of the coordinates for the stacks are not correct and will now be modified.

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.

Area source
So far no area source data has been collected, but some basic assumptions for local enterprise, home cooking and building cooling system will be included into the emission database. It is also 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 have been made 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 during Mission 3 and presented as shown in Appendix G2 of Mission 3 report (Sivertsen et.al. 2003 /NILU OR 84/2003)

Line sources
5 road classes have been classified as

1. High way
2. Road between two towns/provinces
3. City centre street
4. Residential area street
5. Industrial area street

4 vehicle classes have been classified as

1. Lorry (heavy)
2. Van (light)
3. Bus
4. Motorbike

As of April 2004 a total of 77 road nodes with coordinates and 63 road links have been identified. A flat topology has been used for HCMC. The traffic counting has been mainly concentrated on city centre streets and residential area streets.

The validity period for the data collected is 2004. In the test runs performed no time variation has been used so far. (See Appendix G2)

Critical success factors
Most of the required data for traffic data are not available so DONRE has made assumptions for Vietnamese conditions with supplements from European standards provided by NILU. The assumptions for Vietnamese conditions for Emission Calculated Vehicle Classes are Average Model year, Average driving distance, fuel consumption, basic factor, aging factor and speed dependency factor.

Remaining activities
More significant road links will be included into the emission database as basic input for the models. The work collecting traffic densities and traffic distribution number in selected streets will continue.

The project will support financially students to be engaged in further traffic counting. Mr Dam will prepare a schedule for the streets to be counted, and students will be paid to perform the counting according to the procedures developed during Mission 3. The collection of traffic data was also discussed with the Deputy Director of DONRE Mr. Nguyen Van Chien. It was agreed that these efforts are important and must have high priority at DONRE.

7.3 Dispersion modelling

As part of the training workshops and on-the-job training in modelling performed by NILU in Norway, the AirQUIS modelling system was upgraded and finalised for the use in HCMC. (See Appendix G1)

Mr. Dam was trained to use the models and the first model tests have been undertaken based on input data from HCMC. During the test runs at NILU Mr Dam corrected and imported all point sources data (45 stacks) from HCMC with the consumption data and emission factors based on the factors from China.

Some modifications of the coordinates had to be performed before final data could be accepted. Road Nodes and Road Links were prepared for importing into AirQUIS. The traffic data that was counted by the students in HCMC was modified to the templates. At NILU 39 roads with all data needed for running the line sources model has been imported into AirQUIS without the time variation. The emission factors of vehicle were based on the factors provided by NILU.

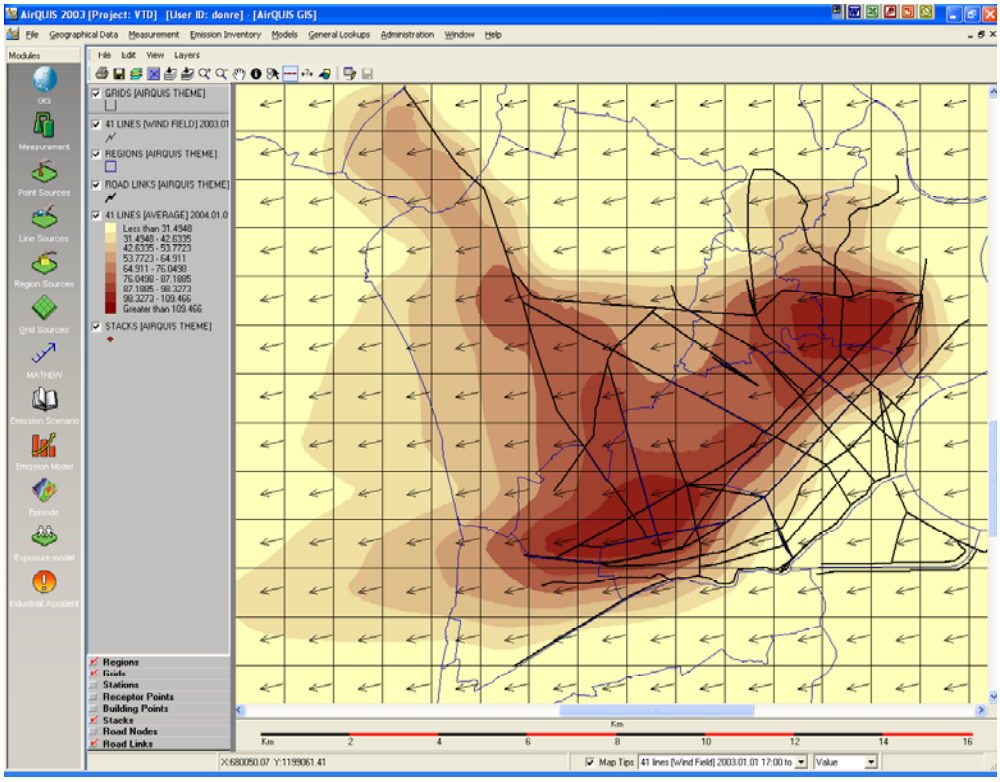

Figure 7.3: A daily average (1 January 2004) NO_2 concentrations as a result of emissions from 41 roads in HCMC produced by the AirQUIS models. The wind field is also indicated.

8 Task 8. Field Operations

8.1 Operational phase

The air quality monitoring system in HCMC has now been entered into an operational phase. All the data from the beginning of measurements have been imported to the AirQUIS database during Mission 3. Data after November 2003 is retrieved to the AirQUIS database automatically, and the database seem as of April 2004 very complete and of good quality.

The field operations require that trained monitoring experts are visiting the stations every week. Other experts are being trained for using the data retrieval systems and the databases. QA/QC at all levels is an important issue that should be kept alive through regular auditing of the system.

Some of the field operators or special assigned experts should be responsible for maintenance, repair and calibrations. The instruments in question contain:

- Automatic gas monitors
- Automatic ambient suspended particle monitors
- Automatic Weather stations

The costs of operations and the elements of a good quality air pollution monitoring system were discussed based on the memo presented in Appendix A4.

8.2 Audits of the monitoring stations

Audits to the monitoring stations from NILU experts has been scheduled to take place during the HEIA project second year of operations. This would assure that operations are following the prescribed operational procedures, and that the monitoring system is operated according to international standards.

A simplified Audit was undertaken to the NORAD financed stations on 20 April 2004. The description of the background was presented in Chapter 5.1 and in Appendix E1. The results of this audit is summarised in Appendix H1.

The main conclusions indicate that the operations are generally well taken care of. In summary we have noted that:

- A few errors on some of the instruments will have to be corrected.
- Some stations experienced power failures, which may damage some of the components
- The station history logbooks are well filled in
- The instrument logbooks are not adequately used as prescribed
- Some intake structures will have to be cleaned
- At two shelters water leakages were reported, which need repair
- The weekly (or bi-weekly) calibrations have not been followed up

Concerning the calibrations, the procedures will be updated as part of the establishment of the Reference Laboratory.

8.3 Maintenance and service

The DONRE field and instrument experts have received some training in instrument operations including maintenance and repair. Mr Dam also received financial support from the HEIA project to participate in an advanced training course held by API in California.

NILU normally recommends a yearly overhaul of the instruments. This will in the future be one of the tasks of the reference and maintenance laboratory.

During Mission 4 the PM_{10} monitor at Quang Trung was checked, repaired and set in operation. The instrument had been working since the installation in 2002. The first record of data from this PM_{10} monitor is shown in the figure below.

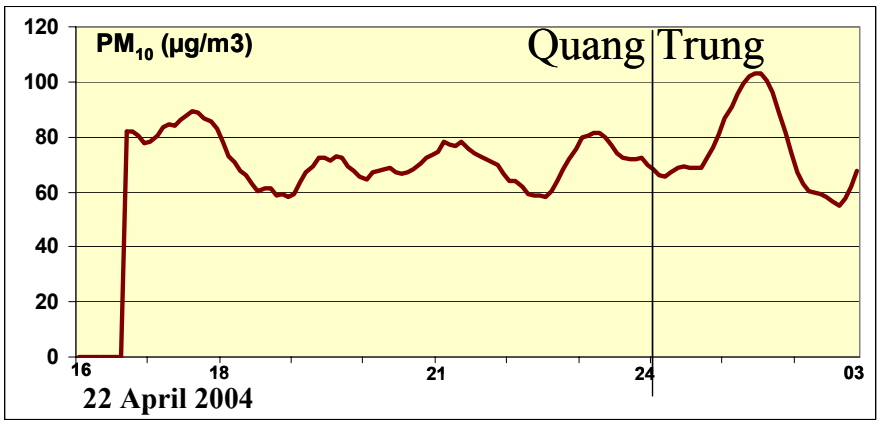

Figure 8.3: PM_{10} concentrations measured every 5 minute at Quang Trung after repair on 22 April 2004.

8.3.1 Weekly check routines

Weekly check routines were implemented after installations in November 2002. This was a follow-up of the routines already implemented by the Danida project. Service forms as presented in Appendix H2 has been developed.

At the shelters a zero air generator and span gas cylinders has to be used for performing weekly manual Zero/Span checks. The zero check shall be based on a zero air generator. The span check is based on a gas cylinder with "normal outdoor" concentration connected directly to the monitor without any dilution and without pressurising the monitor inlet. These two-point calibration procedures have been part of the delivery and installed in the NILU delivered shelters during Mission 2.

An example of the final test and calibration values as found in the history logbooks at the computer centre are presented in Appendix H3. The frequency of theses checks have been reduced, and the procedures will have to be updated as part of the Reference laboratory development and training.

8.4 Consumables and spare parts

Consumables and spare parts have been part of the deliveries and have been stored at the DONRE laboratory. In a letter from NILU of 13 February 2004 the complete list of these spare parts have been identified as presented in Appendix H4. This list was updated in March 2004, as presented in Appendix H5.

The spare parts identified in the attached list had to be returned to NILU after a guarantee period of one year. The spare parts have been made available in case of breakdown or errors in instruments.

New spare parts were delivered to DONRE in April 2004 as shown in Appendix C1. By request from the instrument provider, Industriell Måleteknikk as on 19 April 2004, the API part 005511400, Assembly, Power supply module-230V/50Hz, CE was returned after Mission 4. The remaining parts for the CO monitor M300 will be returned to NILU later.

8.5 Dynamic calibrations

The Reference laboratory will be established at DONRE as part of the additional financial support from NORAD (Appendix A3). A multipoint calibrator with zero-air generator and standard gases will be established in the reference and maintenance laboratory.

The bi-annual (or annual as recommended by CEN and NILU) check and overhaul of instruments will then be combined with a linearity check performed by this laboratory. The required dynamic calibrations will then be performed after instructions and training, which will be provided by NILU.

9 Task 9. Data interpretations

9.1 Understanding AQ

Air quality and meteorological data, which has been imported on a routine basis into the AirQUIS database, has been evaluated and presented. The validity and the content of these data was presented in a workshop during Mission 3.

Based on some of this statistics a layout for the annual report 2003 was discussed during Mission 4.

9.2 Meteorological data

Several errors were identified in the meteorological data already since the beginning of the NORAD financed project. The data have been commented in all Mission reports. Another test was performed during the winter 2004 based on data from December 2003.

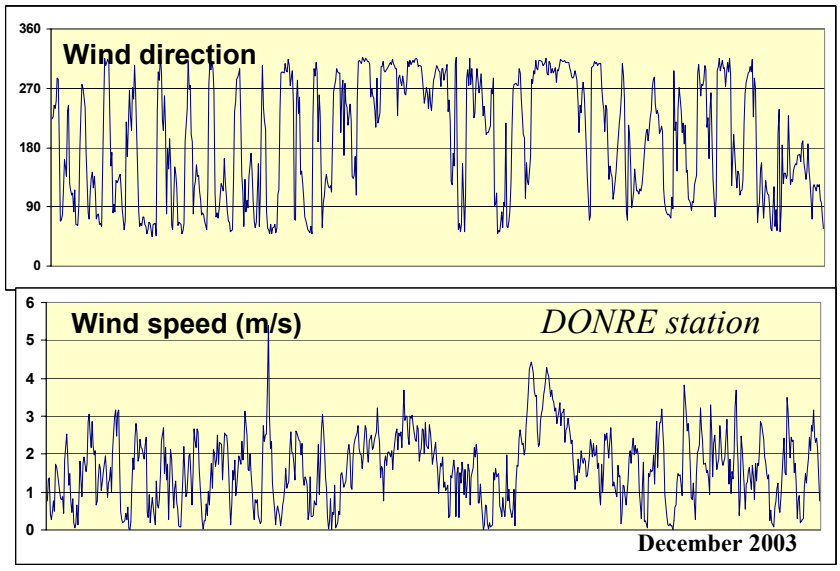

Figure 9.2: Wind directions and wind speeds measured at the DONRE station during December 2003.

As can be seen from the Figure, the wind direction sensors do not register winds from 360 ± 50 degrees (plus-minus 50 degrees around wind from north). This is evidently an error in the sensors or in the data retrieval system. It has not been possible so far to correct for this error. We therefore are considering changing the sensors completely.

The wind speed data look okay. The temperatures and radiation data also seem to be correct, while the temperature measured at the lower level at the shelter is not working at all.

We have also received ten years of meteorological data from the Weather Service. Some of these data are shown in Appendix I1. The data as presented are not suited for use in the dispersion models, as we will need hourly observations given the directions in degrees. It has also been difficult to use these data for evaluation the quality of the continuous measurements at DONRE.

9.3 Statistical evaluation

Air quality data have been evaluated during Mission 4. Time series data were used as background for the Audit to all stations. All time series of data from 17 March to 17 April were evaluated, as shown in one example for ozone presented in Appendix I2.

The quality of the data was also discussed based on various statistics and time plots as shown for ozone in Figure 9.3.

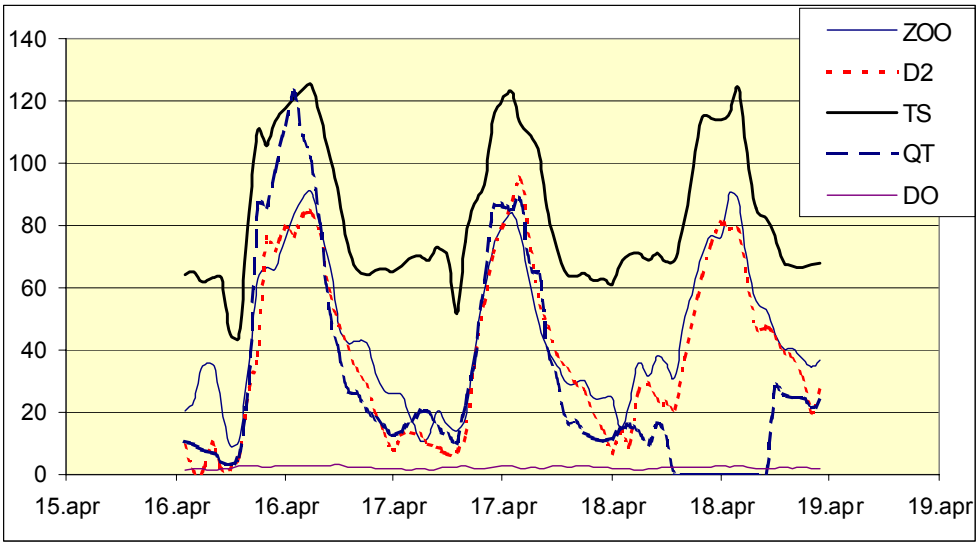

Figure 9.3: Three days of hourly ozone concentrations measured at five sites in HCMC in April 2004.

The results indicated that some of the instruments needed calibration, while one (at DOSTE) is out of operations. Action s were taken to correct the errors.

9.4 Reporting Air Quality, the AQI

The Air Quality Index (AQI) procedures were developed and finalised during Mission 3. The automatic generation of AQI every day has been refined and improved during the winter 2004, and during Mission 4 the routines were again checked and found in perfect operational condition. An example of the presentation of AQI taken from March-April 2004 is shown in Figure 4.2.

The monthly reports will 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 4. A layout and the contents of a typical annual report were agreed upon (See Appendix I3). The first report based on data from 2003 will be produced and discussed with NILU.

9.5 Internet presentations

During a meeting concerning future co-operation a possible Web site for promotion of the air quality management project at DONRE was discussed. It was decided that a web site will be established to promote the air quality monitoring and assessment work that is undertaken by DONRE to day. This web site will describe the HCMC air quality monitoring system and present up-dated air quality data every day.

A schedule for the Web site development will be prepared by NILU and presented to DONRE in May 2004. The presentation will include time schedules and costs involved in the development. The web site may be services completely from NILU. Before released, NILU will need an approval from DONRE including a signed agreement for this part of the work.

See: www.nilu.no and
http://www.luftkvalitet.info/

10 Task 10. Air Quality Assessment

10.1 Use of AirQUIS

DONRE experts have now been trained to use the AirQUIS system for air quality management. The first introduction and training was undertaken during the seminar at NILU in March-April 2003. 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.

Mr Dam visited NILU in February 2004 to receive training in the use of dispersion models, and the first model runs have successfully been presented. (See Figure 7.3.)

Presentation of air quality data aimed at performing air quality assessment will now be based on AirQUIS statistics. Presentations designed for the annual report will push the DONRE experts to use the statistics provided through AirQUIS. Examples are presented in Appendix J1.

Further collection of good quality meteorological data as well as input data to the models will improve the ability to use AirQUIS for air quality assessment and planning. This process is ongoing now.

10.2 Emission inventories

For modelling and planning purposes it is important to achieve a complete emission inventory as possible. Some of the major point sources have been imported to AirQUIS, but more work is needed as indicated in Chapter 7.2.1.

Line sources and traffic data is being collected now. It is assumed that this work will take several months. However, as soon as major roads and streets are implorted to AirQUIS model tests and model estimates may be presented.

10.3 Model exposure estimates

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.

To enable an adequate operation of the models it is important to have good quality meteorological data. 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

As part of the additional funds made available from NORAD it may be possible to continue the training of DONRE experts in the use of AirQUIS for planning purposes. Emission reduction scenarios may be based on the Master Plan or Action Plans available for HCMC. The preparation of emission scenarios based on measures to improve the air quality in HCMC has to be undertaken by local experts.

NILU will perform further training and may support the local experts in operating the optimal abatement tools.

11 Task 11. Capacity building

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

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

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 major part of the training concerning the operations of instruments were given as hand-on training during installation and operation of the monitoring system.
Further training was offered to Mr Dam by API and financed partly by the HEIA project in August 2003.

Additional training will also be a key issue in the development of the Reference Laboratory at DONRE based on the additional funds provided by NORAD.

11.3 Data retrieval and QA/QC

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

The main part of the AirQUIS training programme was based on seminars and workshops given to selected experts from DONRE. This training was undertaken at NILU and presented in a comprehensive report from the seminars. (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. Also modules for emission inventories were presented.

11.5 Use of models

Mr V T Dam was trained in the application of models at NILU in February 2004. NILU experts introduced Mr Dam to different modelling methods. Gaussian models like CONDEP were presented. More details were presented related to the CONCX model. This CONCX model is used for estimating the maximum concentration from single stacks. CONCX is the basic point source model developed by NILU, and it was in the training seminar used to introduce Mr Dam to the model parameters and to understand the models available in AirQUIS.

The schedule for the training sessions at NILU is presented in Appendix K1. Mr Dam presented a memo after the visit to NILU as shown in Appendix G1.

Based on the AirQUIS templates and procedures presented during Mission 3 the DONRE staffs is now 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

Further training may be needed in the preparation of air quality statistics and data interpretations even if this was one of the topics of Mission 3

The preparation of the annual report will be one way of proceeding on these topics.

11.7 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 parallel to the collection of input data. Scenarios will have to be identified, and much of the basic preparations will have to be the responsibility of the DONRE experts.

11.8 Further institutional building

DONRE is under re-organisation. We were told during Mission 4 that a new centre will be established within the next two months. This Environmental Protection Unit (EPU) will consist of 5 sub divisions. The existing air quality monitoring programme for HCMC will be part of the monitoring and evaluation division.

As part of the future work undertaken by the air pollution expert institution, "EPU monitoring and evaluation division" the establishment and operation of a national network for air quality in Vietnam should be discussed with the National Environmental Agency (NEA).

It will be important to build on the expertise established through the NORAD supported HEIA project. The Centre should market its capacity as the main air pollution experts in Vietnam. The establishment of the new centre may thus need further training as part of the institutional building.

Some support may be requested from NORAD by DONRE/NEA linked to institutional building and continuation of the existing NORAD project in HCMC. It seems that it may be difficult to obtain support for further instrumentation from NORAD in the future. DONRE will therefore prepare a letter requesting support for institutional building from NORAD, and NILU will again discuss the matters with NORAD, Oslo

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Appendix A

Task 1. The air quality System for HCMC

Appendix A1: Daily schedules
Mission 4, April 2004

Day	Hr.	Assignment	NILU	DONRE	Done
14 April	10:00	• BS leave Oslo • TNT in HCMC meeting?	 BS, TNT		
15 April	10:20 16:00	 • BS arrives in HCMC • Status, discuss agenda, • Delivery of spare parts and consumables,	BS BS, TNT	LVK, VTD, TrNT, LSQT, NBQ, NTH VTD, TrNT	
16 April	10:0015:00	 • AirQUIS status ; data transfer, measurements, AQI reporting • Ref.lab discussions, structures, activities, tasks and co-operation	TNT TNT	LVK, VTD VTD ++	
Monday 19 April	09:00	• AirQUIS, Evaluation of exisiting data; emission data and met data, • Memo on emission data • Status and performance, discuss results. • Meteorological data - new sensors? • Plan visit to sites? Simple audits	BS, TNT BS BS BS	VTD, TrNT + VTD, LSQT NBQ, NTH	
20 April	09:00 14:00 14:00	 • Site visits, • AirQUIS model result evaluations – training • Memo on maintenance, operations, instruments etc.	BS TNT, BS BS	VTD, NBQ, NTH VTD VTD,NBQ, NTH	
21 April	09:00 10:00	• Future co-operation • Further on emission data; point sources, line sources, area sources. Specify input data	 TNT, BS BS	LVK, VTD, Mrs Toi LSQT, TrNT	
22 April	09:00 14:00 15:00	• Needed input and further training needs identification • National air quality programme • Annual report	BS, TNT BS, TNT BS	LVK,VTD VTD, LVK LVK	
23 April	08:00 09:00	• Meet Director of DONRE, • Summary meetings, reporting final discussion further plans. BS leaves HCMC at 19:30	 BS, TNT BS	LVK, Mr Tran The Ngoc	

The staff

DOSTE	
Mr. Tran The Ngoc	Director of DONRE
Doan Thi Toi (DTT),	Head of Environmental Management Division
Nguyen Thi Tuyet Hoa (NTTH),	PIU Secretary
Le Van Khoa (LVK),	Project Manager DONRE
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 A 2: Memo
Project meeting at NILU 30 March 2004.

Sent by Mail 1 April 2004

Mr Khoa and Mr Dam
First of all let me bring you the joyful message that NORAD yesterday told us in a fax that the 1,7 million NOK has been granted for the establishment of the Reference laboratory at DONRE and for further training. In other words we have more money, we have to include planning in our visit in April, and we will have to discuss the tasks and progress!
We also had a short project meeting here at NILU yesterday to prepare the Agenda. Rolf is ill and is away from NILU till mid May. He had a heart attack during work in Egypt, and I had to send him home right away. He has been in hospital but is home and much better now.
This means that the delegation this time will be:
Mr The Nguyen Thanh and Mr Bjarne Sivertsen

Mr The will spend the Easter holydays in Vietnam
B Sivertsen will arrive in HCMC on Thursday 15 April at 10:20 hrs
I will try to get to DONRE in the afternoon.

The topics for our work and discussions will be:

15 April: Status, discuss agenda, delivery of spare parts and consumables, AirQUIS work
16 April: Ref.lab discussions, structures, activities, tasks and co-operation
19 April: AirQUIS, emission data and modelling, status and performance, discuss results. Meteorological data - new sensors? - Visit to sites? Simple audits
20 April: Site visits, AirQUIS model result evaluations - training
21 April: Further on emission data; point sources, line sources area sources. Specify input data
22 April: National air quality programme? - Needed input and further training - Annual report.
23 April: Summary meetings, reporting final discussion further plans.
BS leave HCMC at 19:30

The visit to all stations and instruments as well as training in repair and maintenance by Rolf will have to be postponed till November 2004. This is, however, well timed according to additional funds and instruments made avaialble from NORAD. NILU will start procuring instruments and test them before shipping them to HCMC. We will have to identify the adequate laboratory, and we will have to inspect your new facilities.
We are looking forward to another fruitful co-operation and look forward to seeing you again on 15 April.
Best regards
Bjarne

Appendix A 3 Letter from NORAD 31 March 2004

NORAD
DIREKTORATET FOR UTVIKLINGSSAMARBEID
NORWEGIAN AGENCY FOR DEVELOPMENT COOPERATION

Telefax

Arkivkode: / *File no.:* 815.3 SRV-2002

Deres/Dykkar ref.: / *Your ref.:*

Vår ref.: / *Our ref.:* 200302311-19

Vår saksbeh.: / *Enquiries:* MN/MN ØV/JDA

Dato: / *Date:* 31.03.2004

Norsk Institutt for luftforskning,

Att.: Bjarne Sivertsen,
Project Manager

Telefax nr. / Telefax No: 63898050
Antall sider / Total pages: 1

SRV-2002 03/310 - HCMC EIP - AIR QUALITY MONITORING COMPONENT– TILLEGGSBEVILGNING.

Til Deres orientering kan det opplyses at NORAD har bevilget NOK 1.732.000,- til videreføring av overnevnte prosjekt.

Bevilgningen er gjort under forutsetning av at det blir inngått en landavtale mellom Norge og Vietnam om finansieringen.

Med vennlig hilsen

Tore Selvig
Gruppeleder

Jan Dag Andersen

NILU
31/3-04 08 0-10143
BS
KAS TNT

Kopi: Kgl. Norske ambassade, Hanoi

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Bankgiro/*Bank account* 6345.05.03012

Appendix A4 : Minutes of Meeting DONRE

Title	**Meeting concerning additional NORAD support**.
Participants	Mr. L V Khoa (LVK), Mr. Vo Thanh Dam (VTD). Bjarne Sivertsen (BS) and Mr. The Nguyen Thanh (TNT),
Distribution	LVK, VTD, TNT,
Author	BS
Date	19 April 2004
Reference No	O-101143

ITEM	**Comments**	Resp
Background	NORAD has confirmed that 1,7 mill NOK will be supported to the project for establishments of a Reference Laboratory including maintenance and repair capacity building, plus additional training for the application of the AirQUIS system for air quality planning in HCMC. *In a letter to SFT/NORAD it was stated that the main objectives were to improve the institutional capacity at DONRE. 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* • *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 about 1,7 million NOK.*	
Tasks	Several tasks will have to be prepared to undertake the additional work. The tasks and responsible institutions were discussed in the meeting.	N, D
Instrument specifications	As part of the procurement phase NILU will prepare a list of specifications, which will be used for the purchase of necessary equipment.	N
Purchase	DONRE and NILU will request the best possible offer for the specified instruments to be shipped to HCMC	D, N

ITEM	Comments	Resp
Ref-lab facility	DONRE will investigate the possible facilities for housing the Reference-, calibration and repair laboratory. The size of the room (3,2 x 6 m) has been indicated by NILU earlier. Shelves, benches air ventilation and other facilities will be specified by NILU and forwarded to DONRE in May 2004.	N
Repair tools	Mr Dam and Mr. Rolf will check available repair tools, and Mr Rolf will prepare a specification for necessary equipment	D, N
QA/QC training	Further training for operation of the monitoring system related to QA/QC procedures has been requested from DONRE. NILU will prepare schedules and perform this training in HCMC	N
Maintenance and repair	On-the job training in maintenance and repair of equipment will be undertaken by NILU. DONRE also requested further training at API in the detailed application of the API monitors. DONRE will investigate possibilities and prices and return to NILU with further specifications.	N D
Modelling capacity	The main task remaining for the test and verification of models in HCMC is the collection of emission data. Further training in the understanding of the basic input to models will be given in a seminar at DONRE.	N
Emission data	Emission data are the most crucial input to models before they can be verified. A selection of point sources and some streets have already been imported. However, there are still much to be performed by DONRE experts.	D
Traffic counting	Traffic counting has started, but most of this work is still remaining. The project will support DONRE economically within a fixed budget to use students for further traffic counting. DONRE will prepare a plan for this work before money is being released.	D
Meteorological data	Other important input parameters for modelling are meteorological data. The quality of the measurement performed presently is not adequate. NILU will improve the sensors and prepare a standard database for future modelling.	N
Model verification and testing	The AirQUIS dispersion models will be run on real data from HCMC as soon as these are available. The models will be verified against measurement data, and then prepared for operational use in air quality planning.	D N
Planning and master plan	When the models are operational for HCMC the impact of various scenarios as e.g. given in the master plan for the city may be estimated and presented.	D
Back up solutions	Data back up solutions have already been installed and is now in operation at DONRE. AirQUIS and model backup will be part of the further development. Upgrading of hardware and software will have to be evaluated, and be part of the future operational costs.	N D

Appendix A5 : Memo

Title	**A sustainable air quality monitoring programme for HCMC – at what cost**
Purpose	Evaluate the annual cost for operating the air quality monitoring programme for HCMC as developed through the HEIA project.
Distribution	Le Van Khoa (LVK), Vo Thanh Dam (VTD), Bjarne Sivertsen (BS) and The Nguyen Thanh (TNT)
Author	Bjarne Sivertsen
Date	21 April 2004
Reference No	O-101143

Introduction

The air pollution monitoring programme developed for HCMC has been a joint effort of DANIDA support and NORAD support. Since December 2001 NILU has supported the technical procurements, preparations, installations and operations of the programme based on funds from NORAD.

To arrive at the present monitoring system has been a long process of procurement, installations, repeated training of several counterparts and continuous on-the job training at all levels. To continue operating this programme as to day with adequate quality and confidence will require that:

- Experts that have received training stay with the future programme (new Centre)
- Instruments, databases and equipment are kept updated and in good quality
- Spare parts and consumables are made available in good time before needed
- Quality assurance programmes are kept at the level originally established.

The normal lifetime of air quality monitors that are being used in the HEIA programme is between 5 and 10 years. This implies that some of the monitors that have been installed since the end of 1999 and 2002 already are approaching the end of their normal lifetime.

This memo roughly evaluates the annual cost for operation and maintenance of the air quality monitoring programme for HCMC such as designed during the DANIDA/NORAD development.

Experts for field operations

The backbone of obtaining good quality air pollution data is linked to sustainability. The main challenges are to ensure that the experts will stay with the programme and that fast and flexible procedures are established for obtaining equipment and resources necessary to operate the measurements.

The field operations require that trained monitoring experts are visiting the stations every week. Other experts are being trained for using the data retrieval systems and the

databases. QA/QC at all levels is an important issue that should be kept alive through regular Auditing of the system.

Some of the field operators or special assigned experts should be responsible for maintenance, repair and calibrations. The instruments in question contain:

- Automatic gas monitors
- Automatic ambient suspended particle monitors
- Automatic Weather stations

Also passive samplers and other equipment may occasionally be used. The people at DONRE have been trained to operate different monitors.

Database and data assessment

The AirQUIS database system has been established at the DONRE computer centre (The Monitoring Institution). The database is used for data retrieval, data controls, data display and storage. It also estimates Air Quality Indexes automatically every day.

AirQUIS also includes an air emission inventory module as well as air pollution dispersion models. The total system is thus capable of performing complete air quality assessment and planning procedures. DONRE experts have been trained to use the models and will in the future be able to perform Environmental Impact Assessment calculations. AirQUIS will thus be the basis for assessment and abatement strategy planning procedures.

The system will thus meet the requirements of modern air quality assessment and will handle a number of air pollution tasks and challenges. It is based on a Geographical Information System (GIS) and it supports direct data and information transfer, data presentation tools as well as statistical and numerical modelling capabilities for now casting and forecasting. It also supports Internet based data dissemination tools.

These databases occasionally need upgrading. Updated computers and hardware systems may also have to be evaluated and considered in the future.

Consumables and spare parts

The operations of the programme will need a number of consumables and spare parts. This will be the case also when the instruments are new and in perfect condition.

Consumables and spare parts should be specified by the operators at DONRE as soon as the need has been identified. This includes such as:

- Calibration gases,
- Pumps and repair kit for monitors where this is needed,
- Filters for various purposes,
- Charcoal, O-rings, fuses etc.
- Repair kit and sensors for met sensors

Consumables and spare parts may be ordered locally, from international dealers or from NILU Products. The updated list of consumables and spare parts available at DONRE should be discussed during the Audit procedures.

Some of the calibration gases are already running at less than 50% remaining capacity. Orders will have to be placed in good time before they are completely empty. Also some of the meteorological sensors are not operating properly and they may need to be renewed.

Instrument lifetime and upgrading

The design, development, construction and installation of the DONRE HCMC air quality measurement programme started in 1997 and were completed in November 2002. DONRE is presently operating 9 stations in HCMC with a total of:

- 9 NOx monitors
- 6 SO_2 monitors
- 6 Ozone monitors
- 5 CO monitors
- 5 PM_{10} monitors
- 1 SM200 PM_{10} sampler (3 are broken)
- 1 Automatic Weather station

To keep up the quality in the monitoring system, as well as assure sustainability we will in the near future have to propose that some instruments are gradually replaced with new instruments. Most urgent may be to forget the SM200 PM_{10} samplers and use PM_{10} monitors instead. The procedures in other countries demand that instruments are taken off field when expensive parts indicate that the lifetime of the instrument has been reached. The instrument is then collected for storage in the laboratory for 5 years, while a new instrument is being installed in field.

It may be possible to modify and upgrade the programme and to reduce the measurement programme by adding dispersion models to the measurement data. This will in the future give an even better total picture of the air quality situation.

Below we have presented a rough estimate for the annual costs related to the existing measurement programme without any modifications, improvements or changes.

Annual costs roughly estimated

Based on the above discussions as well as the experience gained from the present operations of the HEIA programme, we have roughly estimated the annual future costs for continued operations of the air quality monitoring system in HCMC as it is being operated to day.

Estimated Annual Cost of Operations		
Item	**Basis**	**Cost (1000US$)**
Man power, field operations	As present	7
QA/QC and reporting	Additional Ref lab operations	5
Spare parts and consumables	For all instruments, incl. gases	33
Database upgrade	AirQUIS service contract	18
Instrument renewals	15 % annual turnover	54
Infra structures, lines, A/C etc	Estimated as of today	11
Total annual costs		**128**

The costs above include the operations of the air quality monitoring system including, field operations, data retrieval, QA/QC, calibrations, data storage and handling and data presentations. It does not include modelling for specific applications. It also has excluded major data collection for emission inventorying.

The costs for the first 2-3 years may be less than estimated above, as long as the monitors installed in field are still working properly without any major errors. After about 3 years, however, we should expect that the costs would amount to the rough estimate presented above.

Appendix B

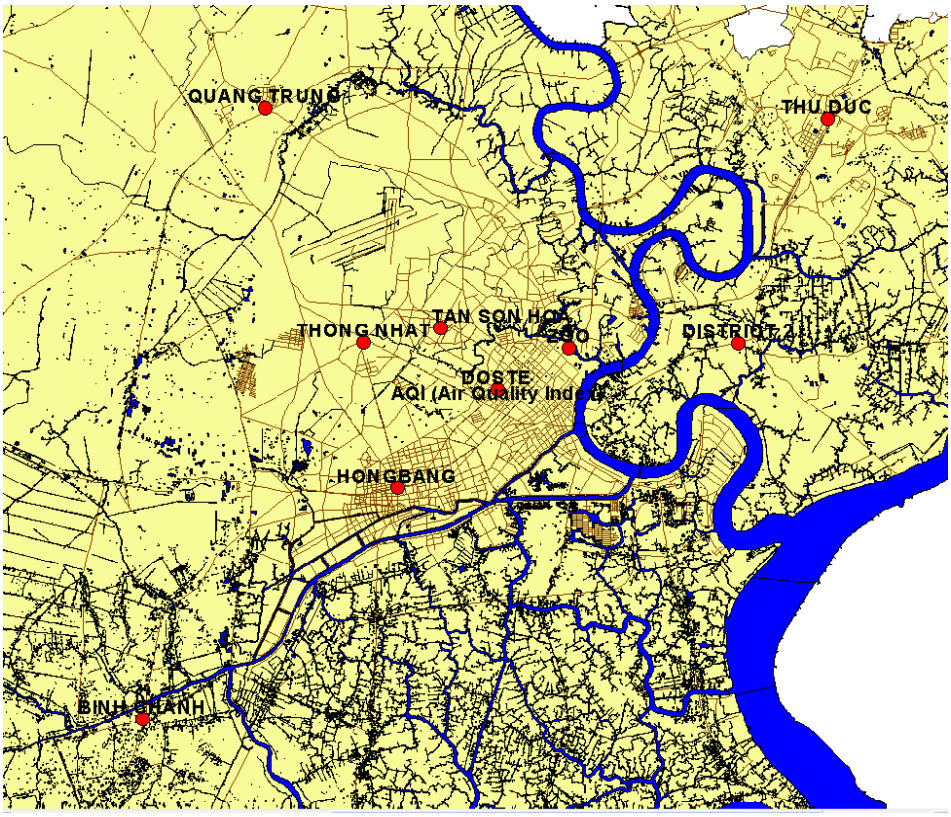
Task 2. Design and update

Appendix B1

The air quality monitoring network in Ho Chi Minh City as operated by DONRE, April 2004.

The following stations are part of the network:

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



Appendix C

Task 3. Procure and install

Appendix C1

Spare part delivered to DONRE 16 April 2004

Part No.	Description	Number
API Model 200A		
KIT000002	Retrofit, O3 Gen Brick, M200A, replaces 0113300000 O3 Generator Assembly	1
014610000	Cooler Assembly	1
	NO2 Permeation Tubes	3
API Model 300		
01810000	Source Assembly (With adapter)	1
API Model 400A		
01590000	UV lamp Power Supply	2
OPSIS Data logger		
	OPSIS IM016, Analogue Signal Module	1
	OPSIS DM016, Digital Signal Module	

Appendix E

Task. 5 Quality Assurance (QA/QC)

Appendix E1 : Memo

Title	Station audits
Purpose	A description of the station audit as performed for the HEIA project by NILU
Distribution	Le Van Khoa (LVK), Vo Thanh Dam (VTD), Nguyen Bao Quoc (NBQ), Nguyen Thanh Huy (NTH), Bjarne Sivertsen (BS) and The Nguyen Thanh (TNT)
Author	Bjarne Sivertsen
Date	16 April 2004
Reference No	O-101143

Station audit

A station audit will include several controls including:

- The station itself (infrastructures)
- Instrument performance including
  - Performance evaluation audit - gas monitors
  - Performance evaluation audit - PM_{10} monitors
  - Performance evaluation audit - High volume samplers
  - Evaluation of Meteorological equipment
- Documents and operational reporting procedures

The audits will be performed by NILU as long as the HEIA project is being supported by NORAD funds. An agreement with NILU may also be established for future audits.

After a complete Audit performed by the NILU, the Reference Laboratory or other institutions appointed to perform the Audit, a Non-compliance report will have to be prepared.

The station itself

The site, shelter, access, and infrastructure has to be evaluated.
Is the shelter clean? Doors, windows, benches, intake structures and racks have to be checked. (See Table 2)

Instrument performance

Are all gas monitors, samplers and equipment working according to specifications. Check logbooks and history logs. Discuss with operators. Receive operators report about previous performance. Reference gases should be identified. Certificates should be available.

Documents and operational procedures

The following documents should be checked and updates should be identified:

- The History log-book manual

- The Station manual
- The Daily data validation manual
- The Standard Operations Procedures manual
- Editing the Operational level documentation
- Location of original documentation on the computer
- Location of stored results on the computer
- Document version control

History logbook
The History logbook includes one section for each instrument at the station and one section for the shelter itself. The instruments are identified by model and serial number.

Station manual
For every station and laboratory there is a station manual. The Station manual is stored at the site.

Station inventory lists
The Station inventory list sections include inventory lists for all stations in the network. For each station the inventory list includes information on instruments and their serial number. Check if the list is complete and updated.

The Equipment history logbook section
For every instrument there is an Equipment history logbook section in the History logbook for the station at which the instrument is running. The Equipment history logbook sections should be stored after the Station logbook section

The Standard Operations Procedures manual
The Standard Operations Procedures manual section includes all SOPs used in maintenance and calibrations both at the station, at the Monitoring lab and at the Reference lab

Location of original documents on computer
Check the original documents. Are they available? Does the operators know the documents and the location?

Completed forms on the computer
Most forms are stored in paper folders. Some forms are stored in data files. These are forms that have been completed by the technicians and stored for later use. The locations of the forms stored in data files are shown in Table 1.

Table 1. Location of completed forms stored on the computer.

Document	Location	Purpose
List of documentation	\QA-QC\Results\Log-book\ List of documentation.DOC	List of documents used at station. One document covers all stations
Working gas calibration - aa[4)]	\QA-QC\Results\Calibration\ WrkGasCal-aa-nn-yymmdd.XLS[4)3)] Sheet Certificate and SO2Cert, NOCert, COCert, HCCert	Calibration certificate. Calibration of SO2, NO, NO2, CO, HC span gas sources
	\QA-QC\Results\Calibration\ WrkGasCal-aa-nn.XLS[4)3)] Sheet SO2, NO, CO, HC	History log. Calibration of SO2, NO, NO2, CO, HC span gas sources
Dynamic calibration - API model aa monitor[2)]	\QA-QC\Results\Calibration\ MonDynCal-aa-nn-yymmdd.XLS[4)3)] Sheet Certificate and SO2, NOx, CO, HC, O3	Calibration certificate. Dynamic calibration of SO2, NOx, CO, HC, O3 monitors.
Two point calibration - API model aa monitor[2)]	\QA-QC\Results\Calibration\ Mon2ptCal-aa-nn-yymmdd.XLS[4)3)] Sheet Certificate and SO2, NOx, CO, HC, O3	Calibration certificate. Two point calibration of SO2, NOx, CO, HC, O3 monitors.
Single point calibration - API model PM10 monitor	\QA-QC\Results\Calibration\ MonPM10Cal- nn-yymmdd.XLS[4)3)] Sheet Certificate, Flow and Mass	Calibration certificate. Single point calibration of PM10 monitors. Flow and mass
Gas meter flow calibration	\QA-QC\Results\Calibration\ SamplerCal-FKNO2-nn-yymmdd.XLS[3)] Sheet Certificate and GasMeter	Calibration certificate. Calibration of dry gas meter
Rotameter flow calibration	\QA-QC\Results\Calibration\ SamplerCal-FKSO2-nn-yymmdd.XLS[3)] Sheet Certificate and RotaMeter	Calibration certificate. Calibration of rotameter
High volume PM_{10}/TSP sampler flow calibration	\QA-QC\Results\Calibration\ SamplerCal-HVTSP-nn-yymmdd.XLS[3)] Sheet Certificate and HVSP	Calibration certificate. Calibration of high volume PM_{10}/TSP sampler

[1)] nn: Station identification number, eg. 08
[2)] aa: Model, eg. 100a SO2
[3)] nn: Serial number of calibration item
[4)] aa: Gas type, eg. SO2

Table 2a: Station and instrument status

Station:		St. Id:			
Technician:		Inst:	DONRE	Present:	Yes
Audit team:	Bjarne Sivertsen	Inst:	NILU/HEIA	Date:	

Station Last visit:

Status	
Walls:	
Windows:	
Door:	
Benches:	
Other:	

	Type	Status	Last Z/S	Last 2pt
Instrumentation	API 200 NOx monitor			
	API 100 SO2 monitor			
	API 400 O3 monitor		Never	.
	API 300 CO monit			
	ESM Andersen PM_{10}			
	Zero air gen.			
	Data logger			
	Air intake	Manifold clean?. Air intake mounted ?		

Table 2b: Operational Documentation

Documentation	Type	Status
	Station manual	
	History log	
	The Station manual	
	The Daily data validation manual	
	The Standard Operations	
	Procedures manual	
	Operational level documentation	
	Location of stored results on the computer	

Other comments

Appendix F

Task 6. Install AirQUIS

Appendix F1

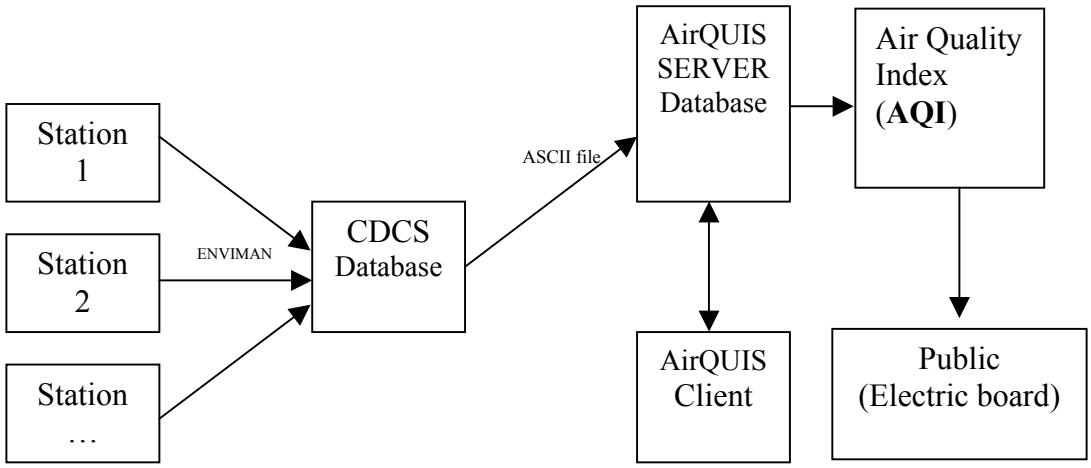
Memo

Title	**Status of AirQUIS application in HCMC – April 2004**
Purpose	Describe the status of the application of all modules of AirQUIS as operated by DONRE in April 2004.
Distribution	Le Van Khoa (LVK), Vo Thanh Dam (VTD), Nguyen, Bjarne Sivertsen (BS) and The Nguyen Thanh (TNT)
Author	VTD
Date	19 April 2004
Reference No	O-101143

AirQUIS version

AirQUIS2003 version 371

Data Flow



There are 9 stations within the monitoring network.

There are often connection problems with transferring data from stations to CDCS at EDC (Environmental Data Center) due to poor telephone line or defect modem after storm. The NORAD stations use the internal modems of OPSIS that can not be found on the IT market in HCMC, so DONRE need keeping some spare parts, specially in the rain season.

There are no problems about automatic import of the ASCII export files into AirQUIS database. If the CDCS has created the export files the AirQUIS will automatically import in database. The message feature showing clearly for the user when time series have not been updated in the ASCII-files when AirQUIS imports new data.
(Attached: Appendix 1- The data collection and importing to AirQUIS form)

Measurement Quality Control (QC) and statistics

Auto QC:
While AirQUIS imports the measurement data, it will automatically check the data by QC flag set-up (Above max, Below min, Too many equal values and Missing). The flagged data will not be included in the AQI calculation.

Manual QC:
Every day DONRE's staff must do a quick vision check of the data to be sure that they understand the values of each component. The checker can flag the data manually in case if they find that data should be marked (like Zero Span check, unusual high values etc.) All QC changes will be logged in AirQUIS.

Statistics:
Every 3 months, DONRE produces environment status report to Ministry of Natural Resources and Environment (MONRE).

AQI

The Air Quality Index (AQI) calculation will automatically run every morning based on the data imported and flagged in AirQUIS. After DONRE's staffs has done manual QC. Sometime they may identify that some components that should not be included in AQI calculation due to e.g. wrong data. These data will then be excluded from the database. The excluded components will also be removed from AQI calculation.

GIS

The following status concerning the mapping of HCMC in the AirQUIS GIS system can be summarised:

- Administrative regions for HCMC are completed.
- Measurement station sites are completed.
- Stack coordinates are under verification.
- Road Nodes and Road links are still under updating.
- Grid: 40EW and 35NS with 1km resolution.
- Additional shape file for river is completed.

Modelling

The AirQUIS dispersion models have been tested for point and line sources. The test runs are under evaluations.

Appendix G

Task 7. Air Quality Modelling

Appendix G1 : Memo

Title	AirQUIS Model training Programmme for DONRE at NILU
Distribution	Le Van Khoa (LVK), Mr. Bjarne Sivertsen (BS), Sam-Erik Walker (SEW), Cristina Guerreiro (CBG), Mr. Rune Ødegård, Mr. Hans Kristian Rygge (HKR), Mr. Ovan Mardal (OMA), Mr. Rolf Dreiem (RD) and Mr. The Nguyen Thanh (TNT)
Author	Mr. Vo Thanh Dam (VTD)
Date	27 February 2004
Reference No	O-101143

Topics	Comments
Spare parts	VTD has delivered all the spare parts to be returned to NILU after the guarantee period of one year, included the spare parts not used (brand new) and the old parts that were replaced in case of breakdown or errors. The list is in Table 1.a **Priority spare parts** DONRE have received the rest of the spare parts in the priority list. These remaining of the priority spare parts will be brought by VTD after the 2 weeks training at NILU. See the Table 1.b for the priority spare part list included the parts sent to VN by Mr. The on December 2003. **Spare parts** Mr. Rolf has ordered the rest of the spare parts needed for all the DONRE stations (DANIDA and NORAD) Table 1.c. The costs of these spare parts will be covered by DONRE. Mr. Rolf will also order the flow meter. **Instruments:** The problems with bad instruments have been revised and given some comments for fixing the errors by Mr. Rolf. The data logger at Quang Trung station does not deliver PM10. VTD will verify this with the data logger from the Zoo station. The monitor display and the data logger shows different PM10 values at Binh chanh station.

AQI and Import

Automatic Import:
The current version used in DONRE cannot automatic import the update data every day. This problem has been solved and Mr. Hans Kristian and new message feature showing more clearly for the user when time series have not been updated in the ASCII-files when AirQUIS imports new data.

AQI:
The results shown on the spread and in the database are the same now. Mr. Ovan made the Exclude Button for each component. This button will be used in case of the user doesn't want to include one or more components that should be removed from AQI calculation due to e.g. wrong data.

Modelling

Meteorology:
Basic knowledge about meteorology like atmospheric stability, diffusion parameters have been presented by Mr. Sam-Erik.

Modelling Methods:
VTD has learned about different modelling methods, some Gaussian models like CONDEP, and specially more details about the CONCX model. This CONCX model is used for estimating the maximum concentration from one stack. CONCX is the very basic point source model to help VTD to understand the model run in AirQUIS easier.

Exercise with Oslo data:
Practical AirQUIS exercise with the Oslo data to get the total picture about how the input data should be prepared to run the models in AirQUIS.

Prepare the real data from HCMC for running the models:

- Corrected and imported all point sources data (45 stacks) from HCMC with the consumption data and emission factors based on the factors from China.
- The coordinates of the stacks are not in UTM system so VTD and TNT have moved the stacks to the supposed "real" area on the GIS. The stack coordinates in AirQUIS are not exactly the same with the real coordinates. This will be corrected after VTD has come back to DONRE.
- Based on the shape file of the roads of HCMC, VTD and TNT have made the Road Nodes and Road Links for importing into AirQUIS. The traffic data that was counted by the students in HCMC has been modified to the templates. Until now 39 roads with all data needed for running the line sources model has been imported into AirQUIS without the time variation. The emission factors

of vehicle were based on the factors provided by Mr. Bjarne. Mr. Rune has shown VTD how to calculate the time variations for traffic.

- Mr. Bjarne will revise the results of the model results.

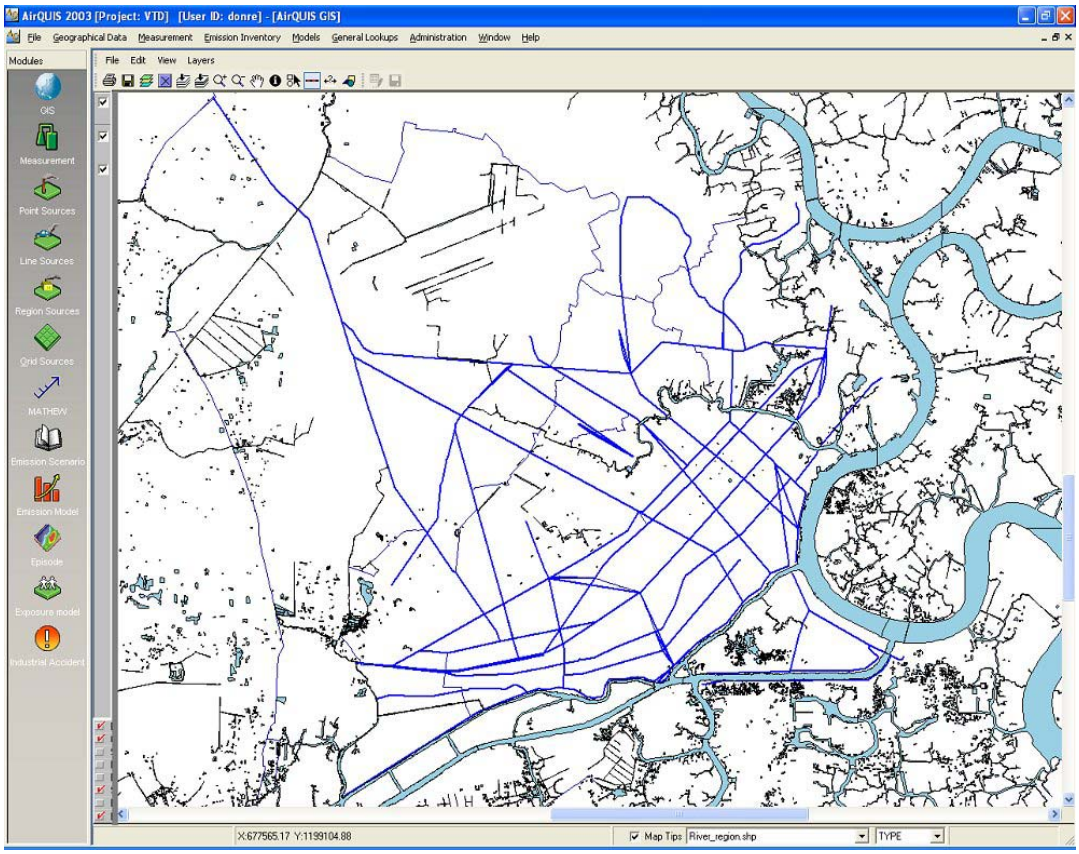
Conclusion:

- The wind direction and the lower temp data are still not correct for running the models.
- Not only the meteorology, the measurements of air quality in HCMC must have good quality by having good maintenance and repair, so the Ref Lab is very useful and needed to be established soon in HCMC by support from NORAD.
- DONRE will continue to collect the point and line sources in HCMC, because more data will give better results.
- The most important data to be collected in HCMC for running the models is emission data of point and line sources together with good and representative meteorological data. This will improve the quality of the EPISOD model results in AirQUIS.
- The extra 2 weeks of training session provided by NILU has given VTD a very good add on value regarding knowledge and hands-on training, which has increased further more the understanding of Air Quality and how to implement an information and planning tool for Air Quality and Management System in HCMC. This training session has been successful conducted by NILU.

Appenidx G2 : Road links counted as of April 2004

Link Definition											
Road Link ID	Road Link Name	Road Class ID	Description	Start Node ID	End Node ID	Length	Direction (1 = Start to End Node, 2 = End to Start Node , 3 = both ways)	Road width 1 (Start to End)	Road width 2 (End to Start)	Road Gradient	Road Link Shape
1	Au Co 1	4		80039	80038	2224.240	3	5	5	0	1
2	Au Co 2	4		80038	80037	1847.640	3	5	5	0	2
3	Cong Hoa	3		80032	80031	3194.320	3	15	15	0	3
4	Bach Dang	3		80002	80009	1658.260	3	10	10	0	4
5	Phan Dang Luu	3		80009	80027	1997.570	3	10	10	0	5
6	Phan Dinh Phung	4		80027	80005	1197.710	3	8	8	0	6
7	No Trang Long	4		80010	80001	3226.840	3	6	6	0	7
8	Le Quang Dinh	4		80008	80007	2627.330	3	5	5	0	8
9	Nguyen Van Nghi	4		80007	80028	1118.330	3	5	5	0	9
10	CMT8 - 1	3		80015	80014	1462.430	3	10	10	0	10
11	CMT8 - 2	4		80014	80042	3509.110	3	7	7	0	11
12	Truong Chinh 1	3		80042	80037	2079.090	3	11	11	0	12
13	Truong Chinh 2	3		80037	80030	5175.160	3	11	11	0	13
14	XVNT 1	4		80003	80002	1408.380	3	6	6	0	14
15	XVNT 2	4		80002	80011	755.226	1	7	0	0	15
16	Dinh Tien Hoang 1	4		80004	80051	217.761	3	9	9	0	16
17	Dinh Tien Hoang 2	4		80051	80012	856.190	1	9	0	0	17
18	Dinh Tien Hoang 3	4		80012	80009	1204.330	3	7	7	0	18
19	Dien Bien Phu 1	3		80022	80013	3574.190	1	10	0	0	19
20	Dien Bien Phu 2	3		80013	80029	1991.170	3	14	14	0	20
21	Vo Thi Sau	3		80014	80012	2207.910	2	0	10	0	21
22	Nguyen Huu Canh	3		80076	80077	2354.740	3	10	10	0	22
23	Nguyen Trai 1	3		80015	80016	4150.040	3	6	6	0	23
24	Nguyen Trai 2	4		80016	80043	1332.340	2	0	12	0	24
25	Lac Long Quan 1	4		80033	80040	1082.320	3	4	4	0	25
26	Lac Long Quan 2	4		80040	80041	1861.800	3	6	6	0	26
27	Le Dai Hanh 2	4		80046	80045	544.596	3	4	4	0	27
28	Le Dai Hanh 1	4		80039	80046	932.796	3	6	6	0	28
29	3 thang 2	3		80049	80014	5061.340	3	8	8	0	29
30	Hong Bang	3		80044	80017	2562.300	3	12	12	0	30
31	Thap Muoi	3		80035	80048	1488.430	1	12	0	0	31
32	Hai Thuong Lan Ong 1	4		80026	80050	560.253	3	8	8	0	32
33	Hai Thuong Lan Ong 2	4		80050	80048	643.978	2	0	8	0	33
34	Tran Van Kieu	4		80036	80026	3643.080	3	4	4	0	34
35	Ben Ham Tu	4		80026	80024	2435.620	3	6	6	0	35
36	Nguyen Tri Phuong	3		80025	80006	2953.100	3	10	10	0	36
37	Ly Thuong Kiet	4		80019	80042	4359.290	3	6	6	0	37
38	Ngo Gia Tu	4		80018	80022	1551.600	3	8	8	0	38
39	Nguyen Chi Thanh	4		80047	80023	3096.020	3	8	8	0	39
40	Ly Thai To	4		80020	80021	1622.780	3	4	4	0	40
41	Hung Vuong	4		80034	80020	5253.280	2	0	5	0	41
42	Nguyen Kiem 1	4		80027	80052	1703.010	3	5	5	0	42
43	Nguyen Kiem 2	4		80052	80028	1390.400	3	5	5	0	43
44	Hoang Van Thu 1	3		80042	80053	250.477	1	10	0	0	44
45	Hoang Van Thu 2	4		80053	80032	1010.220	3	8	8	0	45
46	Hoang Van Thu 3	3		80032	80054	688.374	1	20	0	0	46
47	Hoang Van Thu 4	4		80054	80027	1353.280	3	7	7	0	47
48	Nguyen Van Troi	4		80055	80056	2567.010	3	6	6	0	48
49	Le Van Sy	4		80057	80058	2665.890	3	4	4	0	49
50	Tran Hung Dao	3		80059	80060	3831.060	3	12	12	0	50
51	Ben Chuong Duong	4		80024	80061	3171.400	3	5	5	0	51
52	Nguyen Van Cu	3		80020	80062	1378.100	3	8	8	0	52
53	Nam Ky Khoi Nghia	3		80063	80065	2403.340	1	9	0	0	53
54	Ly Tu Trong	4		80015	80064	1874.660	1	10	0	0	54

The roads counted are shown on the map below (taken from AirQUIS).



Appendix H

Task 8. Field Operations

Appendix H1: Audit report

A simplified audit to the 5 NORAD financed stations in HCMC was performed on 20 April 2004. A brief summary is presented in the following.

Station:	**District 1 - Zoo**	St. Id:	ZO 7		
Technician:	Mr Quoc and Mr Huy	Inst:	DONRE	Present:	Yes
Audit team:	Bjarne Sivertsen	Inst:	NILU/HEIA	Date:	20Apr2004

Shelter and infra structure	Shelter door, benches etc. look okay. Clean. Well kept. Contract with AirCon company for service every month.

	Type	Status	Last Z/S	Last 2pt
Instrumentation	API 200 NOx monitor	Working well.	?	Feb04
	API 400 O3 monitor	Good condition	?	Feb04
	ESM Andersen PM_{10}	Status 1000, checked with Rolf. Happened after calibration 2 Feb 2004 PM_{10} monitor will have to be checked		Feb04
	Zero air gen.	Ok, no comments in log		
	Data logger	Working well, no comments in log		
	Air intake	Manifold clean. Vertical tube. No condensation problems.		

Documentation	Type	Status
	Station History log	Filled in every week. Okay
	The Daily data validation manual	Exists as check list at the computer (monitoring) centre. Filled in every day for all stations and parameters after data retrieval.
	The Standard Operations and Procedures manual	Available at the computer centre
	Operational level documentation	NOx log; no comments since Dec 2003 O3 log last comment 25 Aug 2003 !"factory calibration" = zero/span
	Location of stored results on the computer	Documentation results are stored under operator's file for each station.

Other comments
The Zoo station is safely located, and look generally clean and well kept.

Station:	**District 2 PC**	St. Id:	D2 8		
Technician:	Mr Quoc and Mr Huy	Inst:	DONRE	Present:	Yes
Audit team:	Bjarne Sivertsen	Inst:	NILU/HEIA	Date:	20Apr2004

Shelter and infra structure	Shelter looks okay. Bee hive had established at air intake. Has been removed. Inside temp: 28 degC . Shelter door, benches etc. look okay. Clean. Well kept. Contract with AirCon company for service every month

Instrumentation	Type	Status	Last Z/S	Last 2pt
	API 200 NOx monitor	Okay. System reset 16 March 04	?	Feb04
	API 100 SO2 monitor	Out of order. UV lamp changed. Not calibrated (later?)	?	Feb04
	API 400 O3 monitor	Working well. Last lo 1 Mar04	?	Feb04?
	ESM Andersen PM_{10}	Status 1000, Normal? Seem to work.		?
	Zero air gen.	No comments		
	Data logger	Working well, no comments in log		
	Air intake	Manifold clean. Vertical tube. No condensation problems.		

Documentation	Type	Status
	Station History log	Filled in every week. Okay
	The Daily data validation manual	Exists as check list at the computer (monitoring) centre. Filled in every day for all stations and parameters after data retrieval.
	The Standard Operations and Procedures manual	Available at the computer centre
	Operational level documentation	NOx log had last comment 12 April 2004; ozone flow warning O3 log last 11 March 2004 and then 10 Nov 2003
	Location of stored results on the computer	Documentation results are stored under operator's file for each station.

Other comments

The District 2 station is safely located at the roof of the People Committee building. It looks generally clean and well kept.

Station:	**Quong Trung – Software city**	St. Id:	QT 9		
Technician:	Mr Quoc and Mr Huy	Inst:	DONRE	Present:	Yes
Audit team:	Bjarne Sivertsen	Inst:	NILU/HEIA	Date:	20Apr2004

Shelter and infra structure	Shelter looks okay. Inside temp: 32 degC . Shelter door, benches etc. look okay. During rain season water is coming in to the station. Should be repaired! . Contract with AirCon company for service every month.

Instrumentation	Type	Status	Last Z/S	Last 2pt
	API 200 NOx monitor	Monitor moved in March. Not indicated in the station logbooks!	?	Feb04
	API 100 SO2 monitor	Monitor looks okay. Zero line offset?	2003?	
	API 400 O3 monitor	Working well		11Nov03
	ESM Andersen PM_{10}	Instrument not working since beginning of the programme. Will be checked this week. x)		
	Zero air gen.	No comments		
	Data logger	Working well, no comments in log		
	Air intake	Manifold clean. Vertical tube. No condensation problems.		

Documentation	Type	Status
	Station History log	Filled in every week. Okay
	The Daily data validation manual	Exists as check list at the computer (monitoring) centre. Filled in every day for all stations and parameters after data retrieval.
	The Standard Operations and Procedures manual	Available at the computer centre
	Operational level documentation	NOx log; no comments since Dec 2003 O3 log last comment 25 Aug 2003!"Factory calibration" = zero/span
	Location of stored results on the computer	Documentation results are stored under operator's file for each station.

Other comments

The Quong Trun station is generally clean and well kept. There are occasionally power failures, and the Voltage stabiliser had to be repaired on 12 March 2004.
The calibration gases have been used up to 50% SO_2 and 20% NO.

x) The PM_{10} monitor was repaired on 22 April 2004. Data is being retrieved and they look okay at the end of the Mission 4.

Station:	**Thong Nhat hospital**	St. Id:	TN 5		
Technician:	Mr Quoc and Mr Huy	Inst:	DONRE	Present:	Yes
Audit team:	Bjarne Sivertsen	Inst:	NILU/HEIA	Date:	20Apr2004

Shelter and infra structure	Shelter looks okay but branches from the tree are coming too close to the intake structure. Has to be cut. Inside temp: 28 degC . Contract with AirCon company for service every month. Shelter door, benches etc. look okay. Water is leaking in to the shelter during heavy rains. Has to be repaired! ..

Instrumentation	Type	Status	Last Z/S	Last 2pt
	API 200 NOx monitor	Okay. "Factory calibration" 8 Nov 2003	?	Nov03
	API 100 SO2 monitor	Working well. Last log on 16 Dec 2003		Feb04?
	API 300 CO monitor	Working well		Feb04?
	ESM Andersen PM_{10}	Status 1000, RD? PM_{10} was adjusted at the end of March. (Dam) Not in log book		
	Zero air gen.	No comments		
	Data logger	Working well, no comments in log		
	Air intake	Manifold clean. Vertical tube. No condensation problems.		

Documentation	Type	Status
	Station History log	Filled in every week.
	The Daily data validation manual	Exists as check list at the computer (monitoring) centre. Filled in every day for all stations and parameters after data retrieval.
	The Standard Operations and Procedures manual	Available at the computer centre
	Operational level documentation	SO_2 last log on 16 Dec 2003.
	Location of stored results on the computer	Documentation results are stored under operator's file for each station.

Other comments

The Thong Nhat hospital station is safely located, but is surrounded by braches from a big tree. Water leakage has to be repaired.
Logbooks should be properly filled every time.
About 50 % of the calibration gases have been used.

Station:	**Binh Chanh**	St. Id:	BC 6		
Technician:	Mr Quoc and Mr Huy	Inst:	DONRE	Present:	Yes
Audit team:	Bjarne Sivertsen	Inst:	NILU/HEIA	Date:	20Apr2004

Shelter and infra structure	Shelter looks okay. Inside temp: 32 degC . Shelter door, benches etc. look okay. Air intake structure dusty. Has to be cleaned! Contract with AirCon company for service every month.

Instrumentation	Type	Status	Last Z/S	Last 2pt
	API 200 NOx monitor	Working well. Moved from Quang Trun, when?	?	Feb04?
	API 300 CO monitor	Working well. "Factory calibration" 3 sep 2003		Sep03
	ESM Andersen PM_{10}	Status 1000?? data seem okay		
	Zero air gen.	Nno comment		
	Data logger	Working well, no comments in log		
	Air intake	Air intake very dusty. No condensation problems.		

Documentation	Type	Status
	Station History log	Filled in every week. 13 April power from off to on. Okay
	The Daily data validation manual	Exists as check list at the computer (monitoring) centre. Filled in every day for all stations and parameters after data retrieval.
	The Standard Operations and Procedures manual	Available at the computer centre
	Operational level documentation	Very few comments in monitor log books. Should be upgraded.
	Location of stored results on the computer	Documentation results are stored under operator's file for each station.

Other comments

The Binh Chanh station is safely located. Intake structure need cleaning, otherwise well kept. Power failure occurred in April, power on again 13 April 2004. On 2 April 45 degC in shelter. Instruments okay.

STATION name:	**Date of visit to station:**	**Time of visit:**	**Person conducting check:**

Station exterior	Checked?	**Air intake manifold**	Inspected?
	Damage found?		Cleaned?
Station interior	Checked?	**API zero air generator**	Pressure?
	Cleaned?		Air inlet particle filter inspected?
Air conditioner	Inspected?		Air inlet particle filter replaced?
	Cleaned?	**Air intake teflon lines for API analysers**	Inspected?
			Cleaned/replaced?

Instrument	SM200 PM10	**API100 SO_2**	**API200 NO_x**	**API300 CO**	**API400 O_3**	**ESM PM10**
RED fault light flashing?						
Warning message? (must also be recorded in logbook)						
Observed test value for warning parameter?						
Warning message cleared?						
Manual zero check for CO: API300 zero reading after stable signal (minimum 20 minutes)?						
Manual span check for CO: API300 zero reading after stable signal (minimum 20 minutes)?						
CO gas cylinder closed?						
Analyser sample flow before filter change? (ml/min)						
Analyser particle filters changed?						
Analyser sample flow after filter change? (ml/min)						
Box temperature? (°C)						
SM200 status LED warnings?						
Observed test value for status in buffer?						

Exposed PM10 filters removed for analysis?						
New PM10 filters inserted in clean filter container?						
PM10 sampling head cleaned?						
Instrument surfaces cleaned?						
ESM Status LED warning?						
Status code						
Error code (messages in Comments box)						

Comments-

Appendix H3 :

API Model: **SO_2 Analyzer** Shelter No: **837** Serial No: **1633**

Table : **Final Test and Calibration Values**

Test Values	Observed Value	Units	Nominal Range
RANGE	***500***	PPB	50-20,000
STABILITY	***0.0***	PPB	0.1 - 0.2
PRESS	***26.0***	In-Hg	25 –35
SAMP FLW	***655***	cc/min	650 ± 10%
PMT	***46.1***	mV	0 – 5000
UV LAMP	***3963.8***	mV	2000 – 4000 typical
STR.LGT	***15.5***	PPB	< 100
DRK PMT	***18.2***	mV	-50 - +200
DRK LMP	***-3.2***	mV	-50 - +200
SLOPE	***1.034***		1 ± 0.3
OFFSET	***36***	mV	< 250
HVPS	***614***	V	550 – 900 const
DCPS	***2524***	mV	2500 ± 200
RCELL TEMP	***50***	°C	50 ± 1
BOX TEMP	***31.9***	°C	8 – 50
PMT TEMP	***7.6***	°C	7 ± 1
IZS TEMP	***N/A***	°C	50 ± 0.3
Electric Test & Optic Test			
Electric Test			
PMT Volts	***2001.0***	mV	2000 ± 1000
SO_2 Conc	***1000***	PPB	1000 ± 500
Optic Test			
PMT Volts	***2013.4***	mV	2000 ± 1000
SO_2 Conc	***1010***	PPB	1000 ± 500

Appendix H4

Ho Chi Minh City
Department of Natural Resources and Environment (DONRE)
Environmental Improvement Project, Implementation Unit
63 Ly Tu Trong Street
HO CHI MINH CITY
VIETNAM

Att.: Mr. Vo Thanh Dam

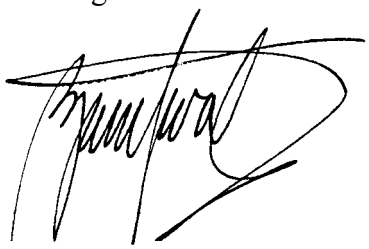
Deres ref./*Your ref.*:	Vår ref./*Our ref.*:	Kjeller,
	BS/SBH/O-101143	13 February 2004

Spare parts

The attached list of spareparts is to be returned to NILU after a guarantee period of one year. The spareparts have been made available in case of breakdown or errors in instruments, which have been purchased by DONRE.

The spare parts will be returned to the storage and as such have no value.

Best regards



Air Pollution Monitoring - Instrument Spares

Part number	Item	Trans 2				Trans 3				Total
		Date	I/O	Quan	Name	Date	I/O	Quan	Name	(Number of spare parts that be send back to NILU)
API Model 100A Spare Parts										
002620100	UV Lamp Assembly	18/04/03	In	1			Out	1	D2	0
003290000	Thermistor Assembly 885-071600	18/04/03	In	1			Out	1	QT	0
004020300	Sensor Board	18/04/03	In	1						1
011390200	Assembly, Power Supply Module 230V/50Hz,CE	18/04/03	In	1			Keep in DONRE	1		0
012360000	Fan, Power Supply Module	18/04/03	In	1						1
013140100	Fan, PMT Cooler	18/04/03	In	1						1
014610000	Cooler Assembly	18/04/03	In	1			Out	1	D2	0
FM000004	Flow Meter, 0-1000 cc	18/04/03	In	1						1
KIT000093	CD, UV Filter 214 NM	18/04/03	In	1			Out	1	D2	0
PS0000010	15V Switching Power Supply	18/04/03	In	1						1
PU0000020	Pump, 115V 50/60 Hz	18/04/03	In	1			Out	1	D2	0
PU0000022	Pump Rebuild Kit, KNF Model #N05ATI	18/04/03	In	1						1
RL0000008	Solid State Relay, 12 Vdc	18/04/03	In	2						2
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			Out	1	BC	0
011310000	Drier Assembly Complete with Flow Control	18/04/03	In	1						1
011390200	Assembly, Power Supply Module 230V/50Hz,CE	18/04/03	In	1			Keep in DONRE	1		0
012360000	Fan, Power Supply Module	18/04/03	In	1						1
013140000	Fan, PMTCooler	18/04/03	In	1						1
014610000	Cooler Assembly	18/04/03	In	1			Keep in DONRE	1		0

Part number	Item	Trans 2				Trans 3				Total
CB0000001	FUSE 03, 1A	18/04/03	In	1						1
HE0000017	Heater, Reaction Cell, 12W	18/04/03	In	1						1
KIT000103	Replacement, Moly Guts, Lona, Type J (Guts only -TC, heater, cartridge)	18/04/03	In	1						1
PS0000010	15V Switching Power Supply	18/04/03	In	1						1
PU0000006	Pump 220V/50Hz	18/04/03	In	1			Keep in DONRE	1		0
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			Will be returned	1		0
006110100	Assembly, Band Heater M300	18/04/03	In	1			Will be returned			1
007930000	Assembly, Fan, PSM (FA0000004 ASSY)	18/04/03	In	1						1
015810000	Source Assembly (with Adapter)	18/04/03	In	1			Out	1	BC	0
016910000	AKIT, Exp. Kit, CO Catalyst	18/04/03	In	1						1
HE0000017	Heater, Reaction Cell, 12W	18/04/03	In	1						1
VA0000002	Solenoid, Stainless Steel, 24V	18/04/03	In	1						1
KIT000109	Replacement, Opto Sensor M300	18/04/03	In	1						1
API Model 400A Spare Parts										
005260200	UV Lamp Assembly, Source	18/04/03	In	1			Out	1	QT	0
006120200	Assembly, Ozone Generator Lamp w/ Piatail	18/04/03	In	1			Out	1	QT	0
011390300	Assembly, Power Supply Module -230V/50 Hz, CE	18/04/03	In	1			Keep in DONRE	1		0
024190000	Assy, Heater, Thermistor, UV Lamp, (M400A/M450)	18/04/03	In	1			Out	1	QT	0
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

Part number	Item	Trans 2				Trans 3				Total
API Model 701 Spare Parts										
014340000	Valve, Shuttle, Drier	18/04/03		1						1
FA0000006	Fan,115Vac		In	1						1
FL0000015	Filter, Air 150LPM, M701	18/04/03	In				Out	1	D2	0
VA0000011	Valve, 4-Way, Drier	18/04/03	In	1						1
VA0000014	Pressure Reaulator		In	1						1
VA0000016	Valve, CHECK	18/04/03	In							1
VA0000017	Valve, 2-Way (Water Drain)	18/04/03	In	1						1
ESM FH 62-1 Dust monitorins										
425451061	RPM reaulated pump, 220V, 50Hz	18/04/03	In	1						1
DPM10/01/00	Diaitel PM 10 Size selective inlet, 1 m^3/h	18/04/03	In	1						1
DPM100100PP	Spare baffle plate for PM10 inlet	18/04/03	In	5						5
Miscellaneous										
	DIN 5, adapter gas regulator (already invoiced)	18/04/03	In	1			Out	1	BC	0
	DIN 8, adapter gas regulator (already invoiced)	18/04/03	In	1			Out	1	D2	0
SUM Trans										

Appendix H 5

Instrument spare part list as of March 2004

Air Pollution Monitoring - Instrument Spares

Part number	Item	Trans 2				Trans 3				Total
		Date	I/O	Quan	Name	Date	I/O	Quan	Name	(Number of spare parts that be send back to NILU)
API Model 100A Spare Parts										
002620100	UV Lamp Assembly	18/04/03	In	1			Out	1	D2	**0**
003290000	Thermistor Assembly 885-071600	18/04/03	In	1			Out	1	QT	**0**
004020300	Sensor Board	18/04/03	In	1						**1**
011390200	Assembly, Power Supply Module 230V/50Hz,CE	18/04/03	In	1			Send later	1		**0**
012360000	Fan, Power Supply Module	18/04/03	In	1						**1**
013140100	Fan, PMT Cooler	18/04/03	In	1						**1**
014610000	Cooler Assembly	18/04/03	In	1			Out	1	D2	**0**
FM000004	Flow Meter, 0-1000 cc	18/04/03	In	1						**1**
KIT000093	CD, UV Filter 214 NM	18/04/03	In	1			Out	1	D2	**0**
PS0000010	15V Switching Power Supply	18/04/03	In	1						**1**
PU0000020	Pump, 115V 50/60 Hz	18/04/03	In	1			Out	1	D2	**0**
PU0000022	Pump Rebuild Kit, KNF Model #N05ATI	18/04/03	In	1						**1**
RL0000008	Solid State Relay, 12 Vdc	18/04/03	In	2						**2**
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) Broke	18/04/03	In	1			Out	1	BC	**0**
011310000	Drier Assembly Complete with Flow Control	18/04/03	In	1						**1**
011390200	Assembly, Power Supply Module 230V/50Hz,CE	18/04/03	In	1			Send later	1		**0**
012360000	Fan, Power Supply Module	18/04/03	In	1						**1**
013140000	Fan, PMTCooler	18/04/03	In	1						**1**
014610000	Cooler Assembly	18/04/03	In	1			Keep in DONRE	1		**0**
CB0000001	FUSE 03, 1A	18/04/03	In	1						**1**
HE0000017	Heater, Reaction Cell, 12W	18/04/03	In	1						**1**
KIT000103	Replacement, Moly Guts, Lona, Type J (Guts only -TC, heater, cartridge)	18/04/03	In	1						**1**
PS0000010	15V Switching Power Supply	18/04/03	In	1						**1**
PU0000006	Pump 220V/50Hz	18/04/03	In	1			Send later	1		**0**
PU0000011	607 Pump Rebuild Kit	18/04/03	In	1						**1**

Instrument spare part list as of March 2004 (continued)

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			Send later	1		**0**
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			Out	1	BC	**0**
016910000	AKIT, Exp. Kit, CO Catalyst	18/04/03	In	1						**1**
HE0000017	Heater, Reaction Cell, 12W	18/04/03	In	1						**1**
VA0000002	Solenoid, Stainless Steel, 24V	18/04/03	In	1						**1**
KIT000109	Replacement, Opto Sensor M300	18/04/03	In	1						**1**
API Model 400A Spare Parts										
005260200	UV Lamp Assembly, Source	18/04/03	In	1			Out	1	QT	**0**
006120200	Assembly, Ozone Generator Lamp w/ Piatail	18/04/03	In	1			Out	1	QT	**0**
011390300	Assembly, Power Supply Module -230V/50 Hz, CE	18/04/03	In	1			Send later	1		**0**
024190000	Assy, Heater, Thermistor, UV Lamp, (M400A/M450)	18/04/03	In	1			Out	1	QT	**0**
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			Out	1	D2	**0**
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) Keep in DONRE	18/04/03	In	1						**1**
ESM FH 62-1 Dust monitorins										
425451061	RPM reaulated pump, 220V, 50Hz Keep in DONRE	18/04/03	In	1				1		**0**
DPM10/01/00	Diaitel PM 10 Size selective inlet, 1 m^3/h Keet in DONRE	18/04/03	In	1				1		**0**
DPM100100PP	Spare baffle plate for PM10 inlet Keep in DONRE	18/04/03	In	5				5		**0**
Miscellaneous										
	DIN 5, adapter gas regulator (already invoiced)	18/04/03	In	1			Out	1	BC	**0**
	DIN 8, adapter gas regulator (already invoiced)	18/04/03	In	1			Out	1	D2	**0**
SUM Trans										

Appendix I

Task 9. Data Interpretations

Appendix I1

Meteorological data

Ten years of meteorological data have been received from the Meteorological Office in Vietnam. The data are presented as daily average values and cannot be used to generate wind frequency statistics (wind roses). The data as presented in the Tables below indicate the predominant wind directions for two summer months (July and August 2000) and two winter months (November and December 2000).

The daytime summer winds most frequently blow from around south west (SW), while the winter night time winds are weaker, more varying in directions and show frequently off-land winds from around north-west (NW).

The data as presented are NOT suited for use in the dispersion models, as we will need hourly observations given the directions in degrees.

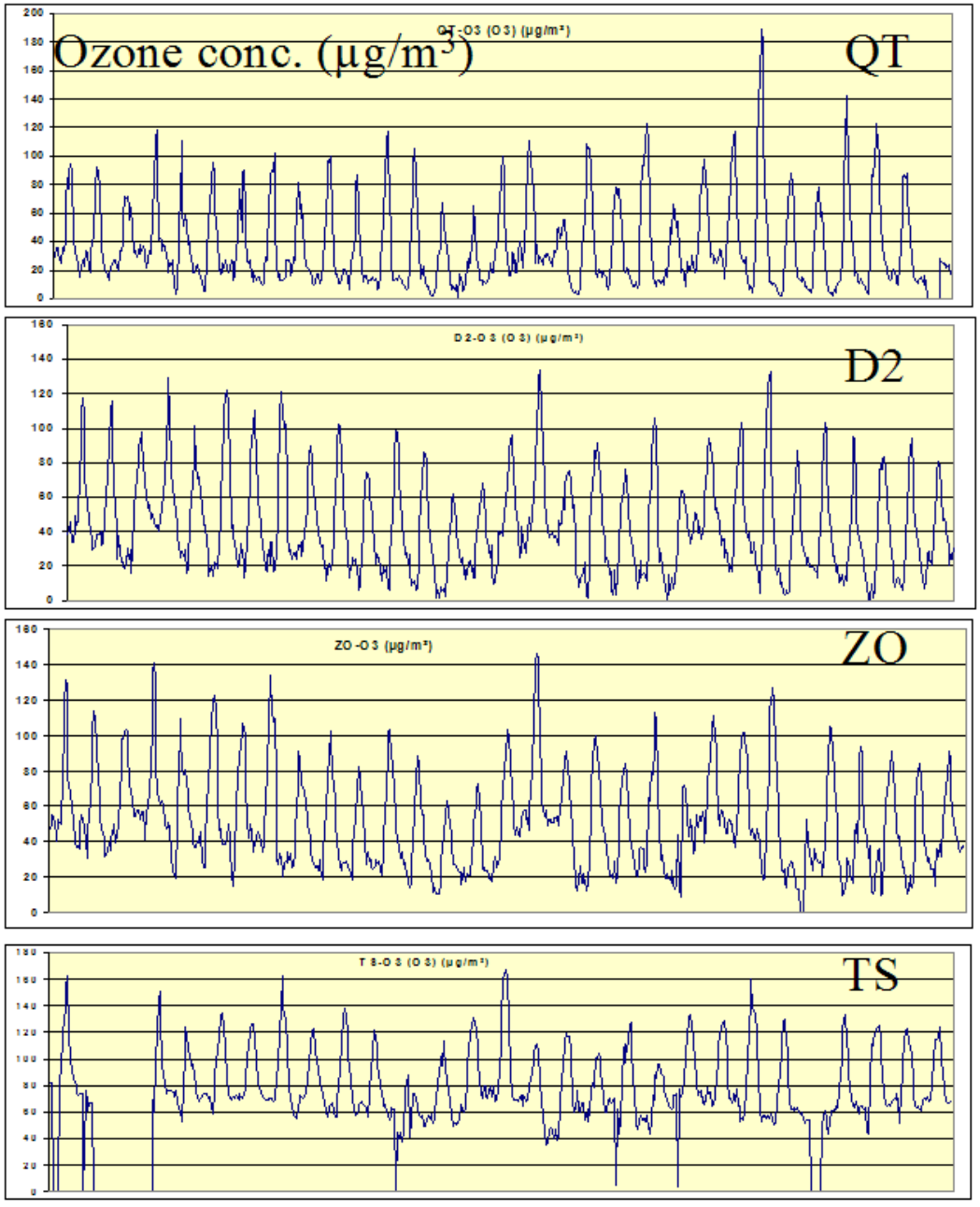
Thaùng	VII								VIII							
	1h		7h		13h		19h		1h		7h		13h		19h	
	höôùng	t.ñoä	höôùng	t.ñoä	höôùng	t.ñoä	höôùng	t.ñoä	höôùng	t.ñoä	höôùng	t.ñoä	höôùng	t.ñoä	höôùng	t.ñoä
1	L		L		SE	4	SE	4	SW	2	SW	2	W	4	SW	2
2	E	3	E	1	SE	3	S	2	L		W	2	SW	3	SW	3
3	SW	2	SSE	3	SW	3	SSE	2	SW	3	SSW	2	SW	5	SW	4
4	SW	1	ESE	2	SE	5	SW	3	SW	3	SW	2	W	4	SW	2
5	SW	2	W	3	SW	4	SSE	2	SW	3	SW	2	SE	3	SW	3
6	W	2	SW	5	W	4	SW	3	SW	2	SW	3	SW	3	SE	2
7	SW	3	SW	3	SW	3	SW	2	L		NE	2	SW	5	SW	2
8	SW	3	SW	1	NNW	3	SW	1	L		E	2	SW	2	SW	2
9	SW	3	SW	2	W	5	SW	3	L		WNW	1	NE	2	SE	3
10	SSW	4	WSW	4	W	4	SW	2	SE	2	L		SW	3	N	2
11	L		SW	3	W	4	SW	2	SW	2	W	2	SW	3	W	3
12	L		SE	2	SW	3	W	3	ESE	4	WNW	3	SW	4	SE	2
13	L		L		SW	1	SW	2	L		SW	3	SW	3	SSE	3
14	NW	2	L		SW	3	SW	3	L		L		NW	6	W	2
15	SW	2	L		SW	3	SW	4	WSW	3	WSW	2	W	3	SW	2
16	SW	2	SW	3	SW	5	SSE	2	L		L		WSW	4	SW	4
17	W	1	SW	3	SW	2	SW	2	SW	3	SW	2	SW	5	SW	3
18	L		L		SW	5	SW	3	L		SSE	3	SW	3	SW	3
19	L		SW	3	W	3	SW	4	L		L		SW	3	SW	1
20	SW	2	SW	2	SW	3	S	2	SW	3	W	2	W	2	SW	3
21	SW	3	W	3	W	3	WSW	3	L		SW	2	W	5	WSW	4
22	SW	2	SW	2	WSW	4	SW	3	SW	4	SW	4	WSW	7	SW	5
23	SW	3	SW	2	W	4	S	2	SW	3	W	3	W	5	SW	5
24	L		NE	2	W	4	NW	3	NW	4	W	3	SW	4	SSE	3
25	SW	2	SSE	2	SW	2	NW	2	L		WSW	3	WNW	4	SW	4
26	W	2	L		SW	3	ESE	3	L		SW	3	SW	3	W	2
27	W	4	L		SW	2	SW	2	SW	2	SW	3	SW	6	SW	5
28	SW	2	SSW	2	WSW	3	SW	2	SW	1	SW	2	W	4	W	4
29	SW	2	SW	1	SW	3	ESE	2	SW	3	SW	2	SW	4	SW	2
30	L		SSE	2	W	5	SW	1	NW	2	WSW	3	W	4	W	2
31	S	2	SW	2	WNW	3	SW	2	SW	1	SW	2	SW	6	SW	3

XI								XII							
1h		7h		13h		19h		1h		7h		13h		19h	
Direction	Speed	Direction	Speed	Direction	Speed	Direction	Speed	Direction	Speed	Direction	Speed	Direction	Speed	Direction	Speed
L		SW	1	NW	2	L		L		L		NW	2	WSW	2
L		NW	2	SW	2	E	2	E	2	NW	2	SE	1	E	1
WNW	2	NW	2	SW	3	SW	3	L		L		ESE	2	S	2
NW	2	W	2	SW	3	WNW	3	S	1	NW	2	SE	2	WSW	2
NW	3	WNW	3	W	3	NW	2	W	3	NW	2	NW	2	S	2
L		E	1	W	3	NW	2	SW	2	NW	2	SW	2	NW	2
NE	1	E	1	SE	2	SW	3	N	2	NW	5	NW	4	SSW	4
SE	2	NW	2	WSW	3	ESE	3	NW	4	NW	3	S	2	NE	2
SE	2	L		SE	4	SSE	3	L		SW	1	ESE	2	E	2
L		NE	1	NE	2	ESE	3	ESE	3	E	1	SW	2	SE	2
E	3	WNW	3	WSW	2	L		N	2	W	2	W	3	SW	1
SE	2	E	1	L		ESE	3	L		SE	1	SE	3	SE	3
N	2	NW	2	ESE	3	SSE	3	SE	3	SE	2	SE	2	ESE	3
NE	3	ENE	2	NW	3	S	2	E	3	NW	2	SW	2	SW	2
SE	2	L		NW	2	SE	1	L		NW	2	SSE	3	S	2
SE	2	SW	2	SW	3	E	3	W	3	WNW	3	NE	3	ESE	3
L		W	2	ESE	2	SE	2	L		SW	1	SE	2	SSE	2
E	2	ENE	2	NE	3	S	1	NW	1	NE	2	SE	2	ESE	4
W	2	L		SE	3	ESE	3	NW	2	S	1	SE	2	ESE	3
NE	2	NNW	2	ESE	3	WNW	1	ESE	3	ESE	2	SE	3	NE	2
L		L		W	2	S	2	L		SSE	2	ESE	2	SE	2
NW	2	NW	2	W	3	SW	2	E	2	L		NE	2	SE	4
ESE	3	NE	1	W	2	SW	2	WNW	3	SE	2	NW	2	NW	2
NW	2	SW	2	SE	3	SE	2	NW	2	L		SW	2	NW	2
SE	2	E	2	ESE	3	ESE	3	SW	2	L		NE	2	E	2
W	3	ESE	1	SE	3	WNW	3	WNW	3	WNW	3	NNW	3	NW	3
L		L		ESE	2	SW	2	NW	2	SW	2	NE	1	WSW	3
SW	2	L		NE	2	WNW	2	L		NW	1	ESE	3	SSE	2
W	2	NNE	2	W	3	S	2	WNW	1	NE	2	ENE	2	S	3
SW	2	L		ESE	2	ESE	2	L		L		NW	3	S	3
								SE	2	L		ENE	3	SE	3

Appendix I2

Ozone data from 4 sites

17 March – 17 April 2004



Appendix I3 : MEMO

1. The annual report

Each year an annual report should be developed by DONRE summarising the air quality as monitored by the HCMC network.
The report should reflect the status of the environment concerning air pollution and it will include information on:

- Average concentration levels
- Exceeding of standards
- Trend analyses; is it better or worse than before?
- Statistics on Air Quality Index values
- Air quality versus meteorology, identify adverse meteorological conditions.
- Major source impact evaluations
- Discussions on source contributions
- Estimate of exposures if possible

In areas and in microenvironments where the air pollution frequently exceeded standard levels, more detailed analyses should be performed. Frequencies of exceeding the standards should be established.

In areas where levels are far below the limit values simple assessment may have been done without any fixed monitoring stations. Historical data based on screening studies using passive samplers may be used for verifications.

Some typical features and contents of the annual report is presented below. For HCMC based on the HEIA data base we should discuss in more details the content of the annual report.

2. Typical Table of Contents

1. Introduction

2. **The Monitoring Network**

3. The Data…
3.1. Data availability
3.2. Data Quality…

4. Meteorological data…
4.1. Winds…
4.2. Temperature
4.3. Stability and turbulence

5. Air Quality Data
5.1. One-Hour Average Concentrations
5.1.1. Frequency distributions
5.1.2. Exceeding of Air Quality Limit values

5.1.3. Typical Diurnal Variations
5.2. 8-hour average concentrations
5.3. 24-hour average concentrations
5.3.1. AQI statistics
5.4. Annual average concentrations

6. Sources of Air Pollution
6.1. Selected concentrations as function of wind directions
6.2. One component vs. another component

7. Conclusions

The following list of Figures and Tables are presented as a guidance. The final selection will depend critically upon the type of problems present in HCMC.

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Figure 2.1: Air Quality Monitoring Sites in HCMC (map and description)

Figure 3.1. Percent of available data for each station (histograms)

Figure 4.1 (A): Wind Direction Frequencies (%) for twelve 30-Degree Sectors (wind roses)

Figure 4.2: One-Hour Average Monthly Frequency Distribution for Northerly and Southerly Wind Directions at the sites

Figure 4.3: The Cumulative Wind Speed Distribution at measurement sites
Figure 4.4: Wind Speed (m/s) Versus Wind Direction
Figure 4.5: Monthly Temperature Statistics Showing Average, Maximum, and Minimum Temperature for each Month

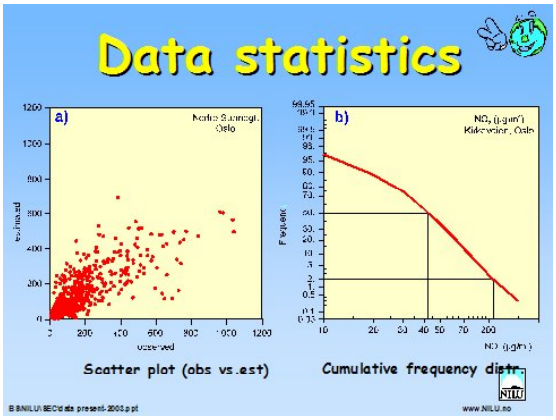
Figure 5.1 (A): One-Hour Average Cumulative Frequency Distribution for SO_2
Figure 5.1 (B): One-Hour Average Cumulative Frequency Distribution for NO_2
Figure 5.1 (C): One-Hour Average Cumulative Frequency Distribution for CO
Figure 5.1 (D): One-Hour Average Cumulative Frequency Distribution for O_3

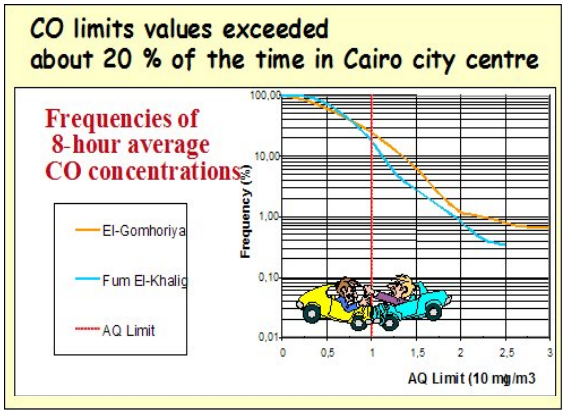
Figure 5.2 (A): Annual Average Diurnal Variation of SO_2 Conc. ($\mu g/m^3$)
Figure 5.2 (B): Annual Average Diurnal Variation of NO_2 Conc. ($\mu g/m^3$)
Figure 5.2 (C): Annual Average Diurnal Variation of PM_{10} Conc. ($\mu g/m^3$)
Figure 5.2 (D): Annual Average Diurnal Variation of CO Conc. (mg/m^3)

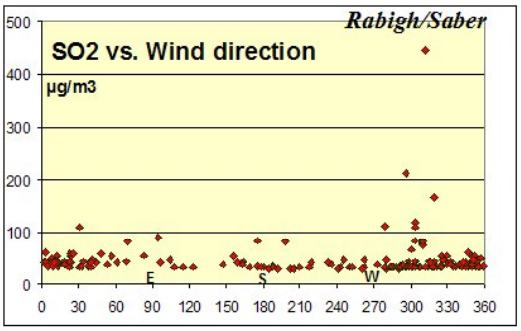
Figure 5.3 (A): 8-Hour Average Cumulative Frequency Distribution for CO Conc. (mg/m^3) Relative to Air Quality Limit Value,
Figure 5.3 (B): 8-Hour Average Cumulative Frequency Distribution for O_3 Conc. ($\mu g/m^3$) Relative to Air Quality Limit Value,

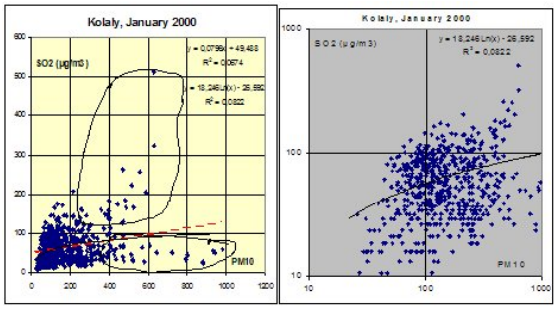
Figure 5.4 (A): Cumulative Frequency Distributions for 24-Hour Average SO_2 Concentrations Relative to Air Quality Limit Values for All Measurements Sites
Figure 5.4 (C): Cumulative Frequency Distributions for 24-Hour Average NO_2 Concentrations Relative to Air Quality Limit Values for All Measurements Sites

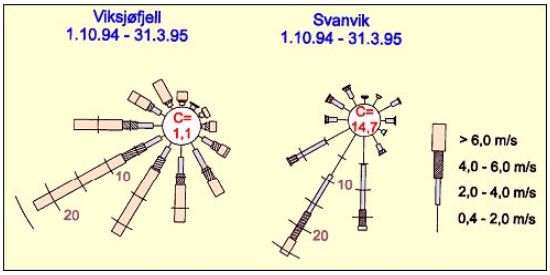
LIST OF TABLES

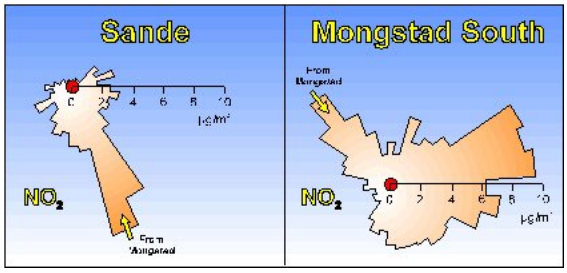

Data statistics
a)
b)
Scatter plot (obs vs.est)
Cumulative frequency distr.


CO limits values exceeded
about 20 % of the time in Cairo city centre
Frequencies of
8-hour average
CO concentrations
El-Gomhoriya
Fum El-Khalig
AQ Limit
Frequency (%)
AQ Limit (10 mg/m3


Rabigh/Saber
SO2 vs. Wind direction
µg/m3


Kolaly, January 2000
SO2 (µg/m3)
PM10


Viksjøfjell
1.10.94 - 31.3.95
Svanvik
1.10.94 - 31.3.95
C= 1,1
C= 14,7
> 6,0 m/s
4,0 - 6,0 m/s
2,0 - 4,0 m/s
0,4 - 2,0 m/s


Sande
Mongstad South
NO2
NO2

Appendix J

Task 10 Air Quality Assessment

Appendix J1 : AirQUIS statistics

The figures below show some typical statistical presentations of data collected during the weeks before Mission 4.

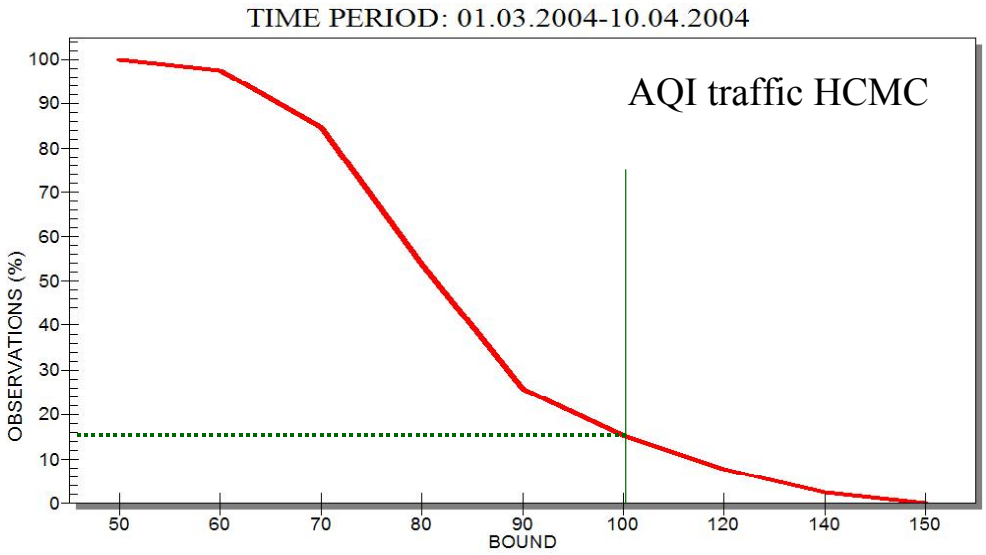


Figure 1: Cumulative frequency distribution of the Air Quality Index (AQI) based on data from traffic stations in HCMC. 1 March – 10 April 2004.

Figure 1 shows that about 16 % of the observations had a daily AQI of more than 100. During these days the air pollution levels probably exceeded the air quality standards for Vietnam.

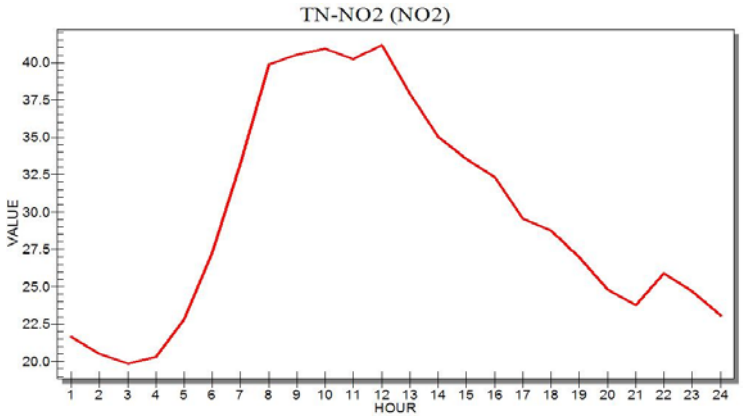


Figure 2: Diurnal variation of NO_2 at Thong Nhat hospital measured in March – April 2004.

The average diurnal variation of NO_2 concentrations measured at Thong Nhat hospital in March-April 2004 is presented in Figure 2.

The highest concentrations were measured from the rush hour started at about 07:00 hrs with an absolute maximum between 08:00 hrs and 13:00 hrs.

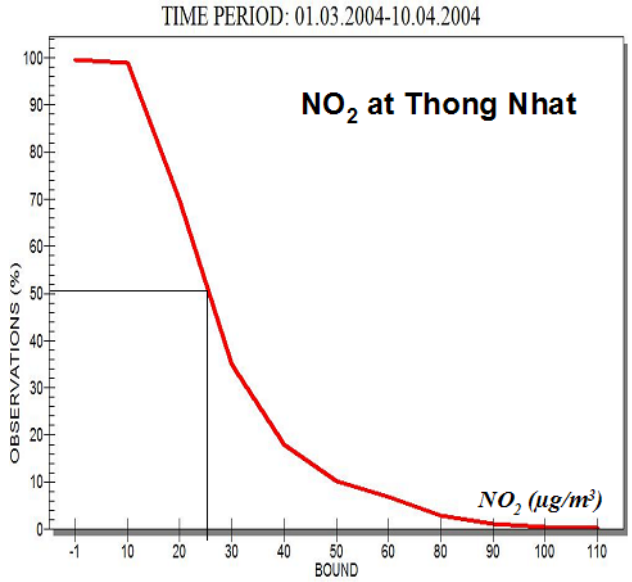


Figure 3: The cumulative frequency distribution of observed NO_2 concentrations at Thong Nhat, March-April 2004.

The median value (50 percentile) was 25 µg/m^3 and less than 1 % of the observations exceeded 100 µg/m^3.

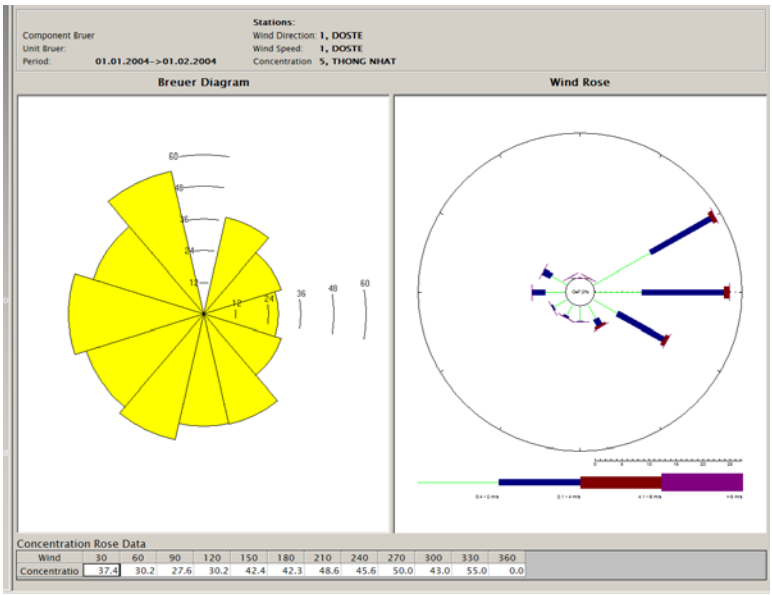


Figure 4: Breuer diagram showing average NO_2 concentrations at Thong Nhat as a function of wind directions at DONRE.

Figure 4 shows that the highest NO_2 concentrations at Thong Nhat normally occurred when it was blowing from the streets.

Appendix K

Task 11. Capacity building

Appendix K1: MEMO

Title	**Schedule for AirQUIS training at NILU, February 2004**
Purpose	A preliminary schedule for training in the application of AirQUIS modellling for Mr Dam, at NILU
Distribution	Le Van Khoa (LVK), Vo Thanh Dam (VTD), Rune Ødegaard (RuO), Sam Erik Walker (SEW), Cristina Guerreiro (CBG), Rolf Dreiem (RD), Gunnar Jordfald(GJ), Paal Berg (PB), Leif Marsteen (LM), Trond Bøhler (TB), Berit Hauger (SBH), The Nguyen Thanh (TNT), Bjarne Sivertsen (BS)
Author	Bjarne Sivertsen
Date	20 January 2004
Reference No	O-101143

Training programme for AirQUIS modelling

As part of the application of AirQUIS in Ho Chi Minh City a training programme for one of the DONRE experts, Mr Vo Thanh Dam, has been scheduled at NILU. The training will take place from 16 to 27 February 2004.

A preliminary programme has been forwarded to DONRE. A more detailed schedule is presented in the following.

Day	Hr.	Programme	Responsible
16 Feb.	0900	Welcome introduction to programme	BS/TNT
	1000	About models, introduction, content, parameters	BS/SEW
	1200	lunch	
	1300	Models in AirQUIS	RuO/SEW
	1530	Further schedule, BS leaving for AbuDhabi next day	BS/TNT/RD
17 Feb	0900	Atmospheric dispersion models	CBG/SEW
	1200	lunch	
	1300	Opening demo in AirQUIS (use existing project)	SEW/RuO/TNT
18 Feb	0900	Instrument maintenance and repair	RD
	1200	lunch	
	1300	Run models outside (CONCX?) and inside AirQUIS	SEW/CBG
19 Feb	0900	Instrument maintenance and repair	RD
	1200	lunch	
	1300	Practical AirQUIS operations, prepare for HCMC data	RuO/TNT
20 Feb	0900	Prepare HCMC data, and run model tests (Stacks)	TNT/ SEW (CBG?)
	1200	lunch	
	1300	Continue using HCMC input data (traffic data?)	SEW/TNT
21 Feb		Weekend	TNT !

Day	Hr.	Programme	Responsible
23 Feb.	0900	AirQUIS application – HCMC data	RuO/SEW
	1200	lunch	
	1300	Questions and answers so far (status data and results)	TNT/RuO
24 Feb.	0900	Concentration distributions, point sources & traffic	SEW/CBG
	1200	Lunch	
	1300	Instrument maintenance (if more instructions are needed)	RD
25 Feb.	0900	Practical work on real data from HCMC (on-the-job-training)	SEW/CBG
	1200	Lunch	
	1300	Modelling exercises continue	SEW/RuO
26 Feb	0900	Status of training (BS back from Dubai)	BS/TNT/RuO
	1030	Continue practical work, modelling	SEW
	1200	Lunch	
	1300	Prepare model applications for impact assessment	CBG/SEW
27 Feb	0900	Bugs and challenges, modelling for planning	SEW/RuO
	1200	Lunch	
	1300	Model interpretations Questions and final statements	BS/TNT/RuO
	1530	End of training	

The programme presented above is tentative.
Changes may be implemented under ways, as progress is made.

Special requests and wishes prepared by DONRE experts may also be added and implemented into the programme.

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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). Mission 4 to HCMC was undertaken from 14 to 23 April 2004, and included further training in the use of AirQUIS models, check the import of air quality and meteorological data as well as the performance of the Air Quality Index procedures. We also tested the emission data and performed model test run. The Mission also included an assessment of further training needs and preparationof schedules for the development of a Reference Laboratory.

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)