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EIMP Phasing-out Phase, 2003-2004

End of Mission Report, Air Quality Monitoring, Mission 05, October 2004

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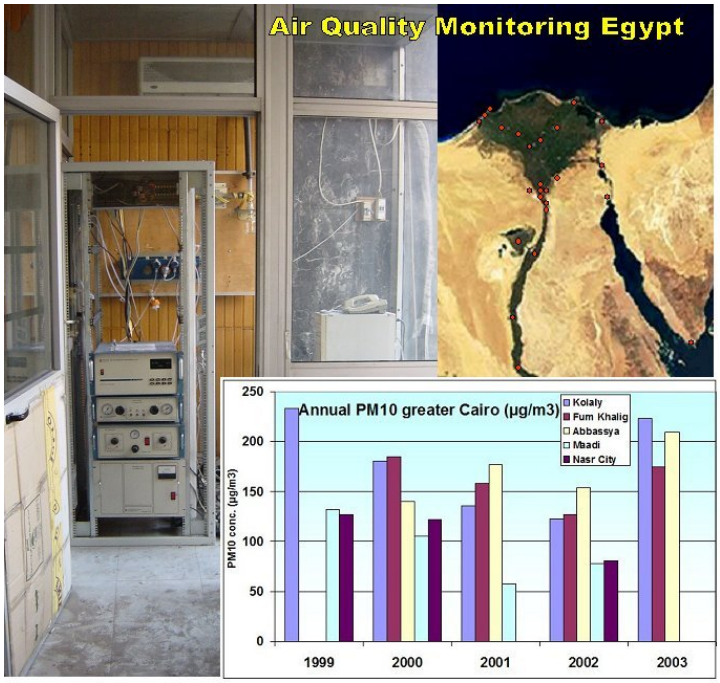


EIMP Environmental Information and Monitoring Programme

NILU Norwegian Institute for Air Research

List of Abbreviations:

AQG(L)		Air Quality Guideline (or limit value)
AQMS	:	Air Quality Management System
ASU	:	Ain Shams University
AWS	:	Automatic Weather Station
BTX	:	Benzene Toluene and Xylene
CAIP	:	Cairo Air Improvement Programme
CEHM	:	Centre for Environmental Hazard Mitigation
CO	:	Carbon Monoxide
Danida	:	Danish International Development Assistance
DAS		Data Acquisition System
DKK	:	Danish Currency Unit
DQO	:	Data Quality Objective
EEA	:	European Environmental Agency
EEIS	:	Egyptian Environmental Information System
EIA	:	Environmental Impact Assessment
EIMP	:	Environmental Information and Monitoring Programme
EPA	:	Environmetal Protction Ahency
ESPS	:	Environmental Sector Programme Support
EU	:	European Union
GD	:	General Directorate (EEAA)
GIS	:	Geographical Information System
GOE	:	Government of Egypt
IGSR	:	Institute for Graduate Studies and Research (Alexandria)
NILU	:	Norwegian Institute for Air Research
NIS	:	National Institute for Standardisation
NO_2	:	Nitrogen dioxide
PM_{10}	:	Particles with diameter less than 10 micrometer
RDE	:	Royal Danish Embassy
SOP		Standard Operations Procedures
SO_2	:	Sulphur dioxide
QA / QC	:	Quality Assurance / Quality Control
TA	:	Technical Assistance
ToR	:	Terms of Reference
TSP	:	Total Suspended Particulate Matter
VOC	:	Volatile Organic Compounds
WHO	:	World Health Organisation

Table of Contents

1 Introduction

The EIMP project was launched in 1996 with the Egyptian Environmental Affairs Agency (EEAA) as the implementing agency for an environmental information and monitoring programme covering institutional support, coastal waters, air pollution, point sources emissions and the development of reference laboratories for improvement of the quality of monitoring data.

The EIMP project is funded by Danida and headed by COWI. NILU was as sub-consultant to COWI responsible for the design, installations, training and operations of the national air quality monitoring system for Egypt, to be operated by experts in EEAA. The design, installations and training of the monitoring network were completed covering 42 sites all over Egypt in July 1999.

The EIMP Phasing-out Phase has been formulated to consolidate EIMP achievements, while gradually integrating the EIMP activities and staff into the existing EEAA administrative and organisational structure.

The objective is to produce relevant data reports on ambient air quality as well as input to EEAA's State of the Environment reports in the form of reliable monitoring data in order to provide a sound basis for EEAA policy and decision-making. During the Phasing out Phase we have also prepared newsletters, prepared and presented papers to assure relevant data dissemination in order to ensure that EIMP data be made available to a larger segment of society and thus be used for developing a demand among the wider public for implementation of appropriate environmental policies and regulations.

The fifth and last Mission during the EIMP Phasing out Phase Air Quality component was undertaken during 18 September to 28 October 2004. Responsible for the Mission was Bjarne Sivertsen. The instrument expert, Rolf Dreiem, spent one month auditing the measurement programme, inspecting the sites and supporting the monitoring institutions in technical questions. Mr. The Nguyen Thanh from NILU also supported the EEAA staff in training them to use a new database, AirQUIS. A test version of AirQUIS was installed at EEAA.

This Mission was the last official Mission by the expatriate experts concerning the EIMP air quality programme. A schedule for the Mission is presented in Appendix A.2. People met during the mission are presented in Appendix A.1. References to previous presentations and summary reports are to be found in the reference list.

2 The Monitoring programme

The EIMP programme is undertaken with technical support from:

- Cairo University, Centre for Environmental Hazard Mitigation (CEHM), Cairo,
- Institute for Graduate Studies and Research (IGSR), Alexandria,
- National Institute of Standardisation (NIS), Cairo.

NIS has been established as the Reference laboratory for the air quality measurement programme, while CEHM and IGSR is operating the field measurements. Meetings were held with the monitoring institutions at CEHM and IGSR to update the status of the monitoring programme as well as discuss possible improvements and changes in the future. The latter discussions were part of the development of a strategic proposal for the establishment of ONE integrated air quality monitoring system for Egypt.

Visits, station audits and continued on-the-job training in operations, maintenance and repair of field instruments were undertaken by Rolf Dreiem (See work notes, Appendix B1).

Also NIS was visited to investigate the operations there relative to the monitoring institutions as well as to upgrade the calibration instruments and to verify that the procedures are in line with the specifications developed for the programme.

2.1 CEHM monitoring status

The objective of a meeting held on 7 March 2004 was to go through the air quality monitoring programme with all operators present. A summary of the meeting included a status report and some action to be undertaken is presented in Appendix B.2.

The Quarterly Report for the second quarter 2004 was discussed and evaluated. Some comments were made concerning the quality control of the report. Dr Tarek stated that this at the end is his responsibility.

The problem of measuring too low SO_2 values from the use of impregnated filters in the NILU sequential sampler have been discussed at several occasions, and some of the reasons have been summarised in a memo (19 September 2004), which was handed to CEHM. A special investigation will be undertaken using different types of instruments. NILU has provided a filter sampler that is used in Europe for manually collection of SO_2 on impregnated filters exposed directly outdoors.

The most important indicator for air pollution in Egypt has proven to be suspended particles in the air measured as PM_{10}. The on-line continuous measurements of PM_{10} are and will be the first priority indicator in the air monitoring programme for Egypt.

A total of 9 PM_{10} monitors have been installed in the programme. Investigations have shown that only half of them are working properly. A main problem is one specific part of the old Wedding instruments, which cannot be produced any more by the instrument provider. This optical coupler (like a photo diode) is not available on the marked, and it is evident that new instruments will have to be purchased to keep up these measurements. The expected lifetime of many of the monitors installed in the EIMP programme is close to be reached.

Appendix B2 describes the situation as of 21 September 2004. NILU has during October inspected and audited several of the stations in Cairo and in the Delta. The situation is not acceptable. As can be seen in Appendix B3 only 33 monitors out of a total of 55 were operating in field in the middle of October 2004. This means that 38 % of the monitors were NOT in operation.

New procedures for PM sampling using high volume samplers and AirMetric samplers were prepared by CEHM. Also the procedures for selection of filters for lead analyses are presented in Appendix B9.

2.2 IGSR monitoring status

A meeting with the staff at IGSR was held in Alexandria on 26 September 2004. The air quality monitoring programme in Alexandria and in the Delta was discussed, as presented in Appendix B.4.

A number of monitors were reported out of order, at calibration or at repair. The programme operated by IGSR is totally missing about 8 instruments. Most of them are out of order or have been at CEHM for repair for a long time.

The meteorological station at IGSR has also been out of function for a long period. Sensors have been taken to CEHM. New sensors from the store have to be installed as soon as possible.

Some of the proposals for changes to the monitoring programme in Alexandria were discussed again. A site visit was paid to one of the areas identified for future measurements. A good representative site was found at the Municipal waste handling facilities in ElAwaid area. The site is downwind from Alexandria relative to the prevailing winds in the area. It will be a residential/urban background type site. It was suggested that the AlAsafra instruments could be moved to one of the new sites.

It was also suggested that the instruments at Abu Quir should be moved westwards to be downwind from paper companies at El Tarh. The fertilizer industries at Abu Quir have been cleaning up and reduced their emissions.

2.3 Upgrading the PM_{10} monitoring network

A result of the assessment of air quality in Egypt has shown that particulate matter (PM) is the most critical air pollutant. The EIMP programme has concentrated most of the efforts on measurements of PM_{10} as an indicator for PM. We also have seen the importance of on-line information, which will require that some of the instruments used will have to be automatic monitors reporting data on telephone lines to a central laboratory or to EEAA. Also manually operated PM instruments are used in the system.

The normal lifetime of air quality monitors that are being used in the EIMP programme is between 5 and 10 years. This implies that many of the monitors that have been installed since the end of 1997 till 1999 already are reaching the end of their normal lifetime.

In Appendix B5 we have presented the background and the needs for new PM_{10} monitors. It shows that the EEAA air quality monitoring programme will need at least 10 monitors on-line operating properly with adequate QA/QC and calibration procedures. Also necessary consumables and spare parts have to be made available.

One of the main reasons for the break down of many of the old Wedding type PM_{10} monitors has been a total "time-out" of the photo diodes. Most of these instruments have been in operations under the EIMP project since 1997 and some of the instruments are ready for replacement (See Appendix B6).

A rough cost estimate indicated that the upgrading of the PM network for EEAA would cost about 940,000 LE. The total annual operational costs have been previously estimated to about 2 million LE (Mission 04, Appendix E1, Sivertsen and Dreiem, 2004).

2.4 The SO_2 concentration levels

The problem of measuring too low SO_2 values from the use of impregnated filters in the sequential sampler has been discussed at several occasions. In the meetings with the monitoring institutions we suggested a test to verify what was going on.

Some of the reasons for the "problem" are summarised in Appendix B7, and the operating teams were asked to prepare a test measurement period to verify discrepancies again. A simple procedure for this has been presented in Appendix B8. Some sites have been selected for these studies such as:

1. Tabbin south; sequential sampler, passive sampler and EMEP sampler
2. Nasr City: sequential sampler, passive sampler and EMEP sampler
3. ElShouhada: SO_2 monitor, sequential sampler, passive sampler and EMEP sampler

The experiment should be undertaken over one week at each site. It may be possible to select several weeks more sites if required.

2.5 Meteorological data

All the meteorological stations are not working adequately yet. In the Cairo area data from Abbaseya and Tabbin seem to be of sufficient quality. Wind data from Kaha, Shoubra and Giza has not yet been sufficiently verified and tested, However,

it will in the future be important that at least Abbaseya, Kaha, Giza and Tabbin will work properly.

In the Delta as well as in Alexandria the automatic weather stations did not work properly. Here it will be important that the meteorological station at IGSR will be repaired and set in operation again. The meteorological station in El Mansura has been proposed moved to Kafr Zayat in the future monitoring programme.

Meteorological data from Aswan has not been made available for the last 6 months.

2.6 Calibration routines

The field calibration system was changed and upgraded in the beginning of November 2003. After starting to use Working Standard Gases to make a span check every week the 145 Calibrator is only used to make zero air.

We verified in March 2004 that EEAA had only purchased 14 regulators. To assure that proper calibrations are performed at all station we proposed that EEAA purchased more regulators to enable smooth and safe operations of the calibration procedures. This was also discussed with the Reference Laboratory representative and presented to EIMP and to the Danida ESP (See Mission report 4, Appendix B5).

During the Audits to the stations performed by expatriate experts during this Mission it was seen that proper calibrations had not been undertaken at some of the sites. Actions were taken to correct this.

2.7 Update the EIMP air quality monitoring programme

Discussion of new sites and changes to the EIMP air quality monitoring programme have been held as part of the planning of the future national air quality monitoring programme for Egypt (See Chapter 5).

Measurements at a new site identified in Suez started during the summer of 2004. Preparations of shelters and infrastructure at the new sites in Beni Suef are under way. Two permanent sites have been selected in Beni Suef to contain automatic monitoring equipment. Meteorological measurement will be undertaken along a 10 m mast at the station located at the roof of the Governerate building. In addition to the permanent monitoring sites, a few passive sampling sites will be assigned.

In the Cairo area it was proposed to develop a new monitoring station in Heliopolis. Proposals for a future monitoring system in Egypt have been presented in a separate report. (Sivertsen 2004). There is also a new site proposed in the Governerate of Sharqiya to monitor the plumes generated from burning of agricultural waste in eastern Delta. The site proposed is located between Bilbeis and Minyet ElQamh, in the small village of Nishwa.

Other sites have also been evaluated as part of the new updated national monitoring programme for EEAA. In Alexandria the shelter and instruments from AlAsafra will be moved to the Municipal waste handling facilities in ElAwaid area. The site is downwind from Alexandria relative to the prevailing winds in the area. It was

also suggested that the instruments at Abu Quir should be moved westwards to be downwind from paper companies at El Tarh.

3 QA/QC and the Reference Laboratory

3.1 Audit programme from NIS

A seminar was given by NIS on 29 September 2004 based on the audits performed during January to June 2004. Audits from NIS are presently undertaken as a routine programme. Dr Adel B Shehata (Quality Manager at NIS) presented the conclusions from the Audits performed in 2004. Some comments and results are presented in Appendix C1.

Some non-compliance reports have been given to the monitoring institutions, and corrective actions have been received and much of the corrections have been undertaken. Also general comments have been presented to many of the audit reports from the monitoring institutions.

3.2 Dynamic calibrations

NIS is supposed to verify the multipoint calibrations performed by CEHM. Monitors have to be collected from the sites for dynamic calibrations every year. Dr Samir at NIS requested these monitors. He stated that all ozone monitors have arrived at NIS, while other monitors had not turned up. He further stated that according to the contract NIS is supposed to “calibrate” a total of 19 monitors in 2004. Only of few of these have been turned in so far

B Sivertsen requested a list of the monitors, which are to be verified by NIS in 2004. This list should be sent to the Monitoring Institutions. The list appeared a few days after the meeting and sent by fax to the Monitoring Institutions as seen in Appendix C2.

3.3 Calibration differences NIS - CEHM

Monitor calibrations undertaken during March 2004 have revealed a difference between calibrations performed at CEHM and at NIS. This will have to be further studied and the reasons identified and corrected. The documentation is presented in Appendix C3. The largest deviation between CEHM and NIS for SO_2 was 10.9 % for NOx 17.4 %. Some of the possible reasons for these differences have been looked into, but no final conclusions have been drawn so far.

3.4 Audits performed by the expatriate experts

Audits and inspections were prepared and undertaken to a selection of measurement sites in Cairo, Alexandria and the Delta. The sites selected for audits by the expatriate expert are supposed to be among the future first priority sites.

Audit reports are presented in Appendix C4 for two of the sites visited. A complete presentation of Audit reports is presented in a separate report. (Dreiem, 2004)

The following sites were visited for these audits:

- Cairo:
  - Gomhoreya Street
  - Tabbin
  - Fum AlKhalig
  - Abbasseya
  - Quolaly
- Alexandria:
  - El Shouhada
  - IGSR
  - Alex regional site
- Delta:Kafr Zayat
  - El Mahalla

A main conclusion is that the sites in Alexandria and the Delta need to be updated. Shelters are in bad condition and calibrations at ElShouhada had not been properly undertaken since March 2004. This has now been corrected for.

The site at Tabbin was working satisfactory except for the TSP sampler, while the other sites in Cairo had failures and errors, which mainly were caused by instruments not operation perfectly, and missing spare parts.

Generally it has been noted that the follow-up programme from the QA/QC officers does not seem to work properly. The field operators have to file station logs and history logs, which again will have to be checked and verified by the QA/QC manager.

3.5 Calibration gas responsibilities

Presently the organisation of calibration and the purchase of international reference gases in the air quality monitoring programme are not satisfactory according to Ulla Lund's discussions with the Reference Laboratory. Her proposals are presented in Appendix C5.

In the present organisation both the Reference Laboratory and EEAA are involved in purchase of gases and calibration services from abroad. When gases are expired, the Reference Laboratory blames EEAA and no doubt EEAA may say that the Reference Laboratory did not give due notice of their need. Both may be right or wrong but that is beside the point. The point is that the system does not ensure that there is only one place to lay the blame if certificates are expired.

Ulla Lund therefore recommends that EEAA add the costs for consumption of reference gases and calibration services abroad to the contract for Reference Laboratory.

4 Reports

4.1 Daily reports

Daily reports of the air quality in Cairo are still being produced and presented to the minister's office. There was a request for redesigning these reports, and a first proposal was prepared on 24 September 2004. The proposal is presented in Appendix D1.

Later the daily reports were simplified to present a simple statement of the air quality based on the air quality index (AQI) approach. An example of a typical daily report as developed in October 2004 is shown in Appendix D2.

4.2 Air Quality Index (AQI) developed for Cairo

The daily reports of the air quality in Cairo as shown above are using the air quality index (AQI) for characterising the air quality through simple index values. The approach has been tried in a simplified form through a classification scheme linked to the development of air quality forecasts. A first classification for the Cairo air quality was based on only measurements of PM_{10}.

Also as part of the daily reporting of the EIMP programme a classification scheme was presented based on internationally recognised methods for characterising air pollution through AQI values. Appendix D3 summarises the background fro AQI developments and evaluates the methods used by the forecasting system at EEAA.

We have recommended that the AQI system developed for EEAA is harmonised and used in the future for classifying the air quality, especially in Cairo, in an objective and systematic way.

4.3 Monthly reports

A data summary report issued every month in Arabic language presents the air pollution concentrations based on preliminary data. A short version of the report for June 2004 is presented in Appendix D.4.

The concentrations were in general lower than measured during other months, especially the winter months. High concentrations of SO_2 had been measured at the site in KomOmbo, which is located only 1 km south of a sugar factory.

The measurements show monthly average PM_{10} concentrations of more than twice the 24-hour average limit value of 70 µg/m^3 at 5 sites in Egypt during June 2004: Kafr Dawar, KomOmbo, Shoubra, FumAlKhalig and Tanta.

4.4 Quarterly reports

The quarterly reports produced by the monitoring institutions have been used as part of the training in understanding the air pollution data collected. Quarterly reports for the second quarter 2004 were presented by CEHM and IGSR during the Mission. The reports were evaluated and corrected by B Sivertsen.

They were presented to the Monitoring Institutions again and some on-the-job training in data interpretation and data evaluation was undertaken.

The conclusions from the IGSR report were especially discussed, and were changed to reflect the findings of the report. As an example the Figure 1 below represents a summary of SO_2 and NO_2 concentrations measured by passive samplers at 5 sites in Alexandria and the Delta.

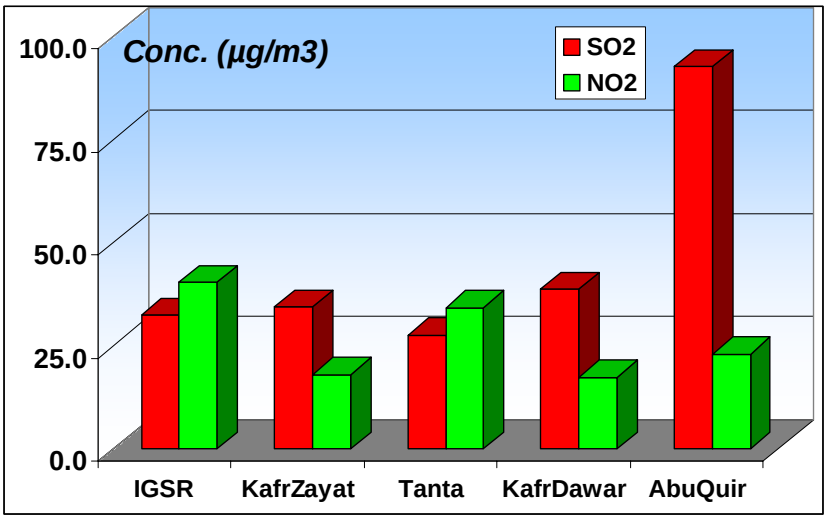


Figure 1: Average integrated SO_2 and NO_2 concentrations measured by passive samplers in April to June 2004.

SO_2 concentrations range between 30 and 40 µg/m^3 except at the new site west of AbuQiur. The typical average SO_2 concentration was 92 µg/m^3, which is above the limit value for Egypt. The samples are collected downwind from paper companies at El Tarh.

4.5 Reporting high air pollution days in Cairo

Periods of high air pollution levels have been observed frequently during the last few years in Cairo due to high emissions of air pollutants from different sources combined with specific meteorological conditions.

During the month of October these so called episodes may be caused by a combination of low-level sources inside the city of Cairo, burning of agricultural

waste in the Delta and unfavourable meteorological conditions. We have previously discussed air pollution episodes and the physical properties of the atmospheric conditions (See EIMP Newsletter May 2001).

Also in October 2004 we had several days with PM_{10} concentrations and concentrations of gases exceeding typical average concentrations as well as limit values. One such period occurred during the last few days of September and into October as described in Appendix D5.

4.6 Dust from agricultural waste burning in the Delta

In some cases the plumes of dust were also observed moving into Cairo in the morning hours from north-northeast. Satellite pictures have also revealed that during theses days there were fires observed over the eastern part of the Delta. Wind trajectory analyses also indicated transport of air from the north-northeast towards Cairo. One such case is shown for 11 October 2004 in Appendix D6.

This pattern was observed several days in October 2004. To identify the importance of the burning of agricultural waste in the Delta compared to the number of local sources inside Cairo, we may have to analyze a selection of filters collected during the days of interest.

4.7 A summary of air pollution in Egypt

A summary of the air pollution situation in Egypt has been prepared. Statistics have been performed on the five-year of data from 1999 to 2003. Also analyses of the 2004 data have been compared to development and trends of air pollution in Egypt.

The largest air pollution problem in Egypt has several times been proven to be linked to suspended particulate matter. Figure 2 below, shows that the probability of exceeding the air quality limit values for 24-hour average PM_{10} concentrations is often between 90 and 100 %.

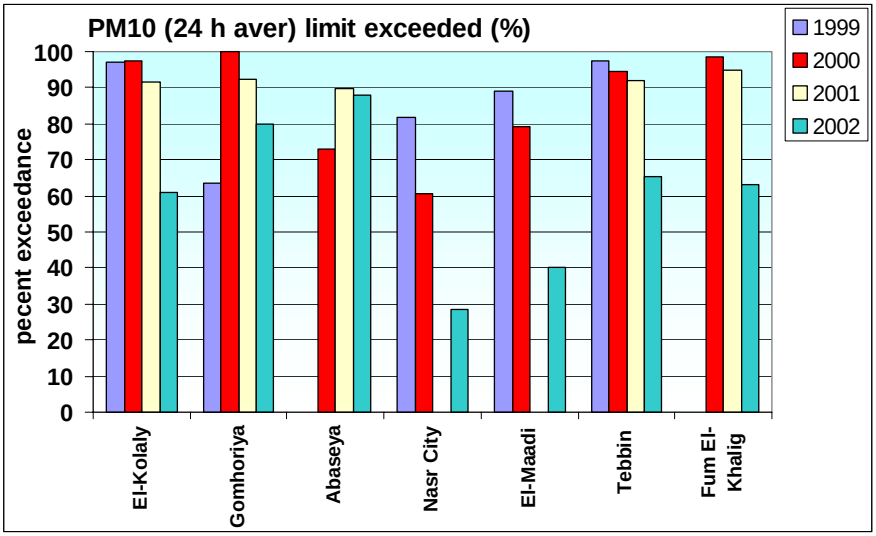


Figure 2: The frequency of the exceedance of the PM_{10} limit value for 24-hour average concentrations as measured at 7 sites in Egypt for 4 years (1999-2002).

There was a tendency for fewer exceedings in 2002 than in 2000. This situation is studied in more details in the state of the air quality report.

The monthly average PM_{10} concentration levels as observed by the CAIP AirMetrics station network ranged between 150 and 230 µg/m^3. This a long term average level, which we do not find in many areas of the world. The conclusion is that Cairo is probably one of the most polluted cities in the world when suspended particulate matter is concerned. (See Appendix D7).
Except for the PM_{10} levels the one-hour average gas concentrations are not often exceeded as the limit values set for Egypt are rather high. An example of the frequency of exceeding the SO_2 limit is presented in Figure 3 below.

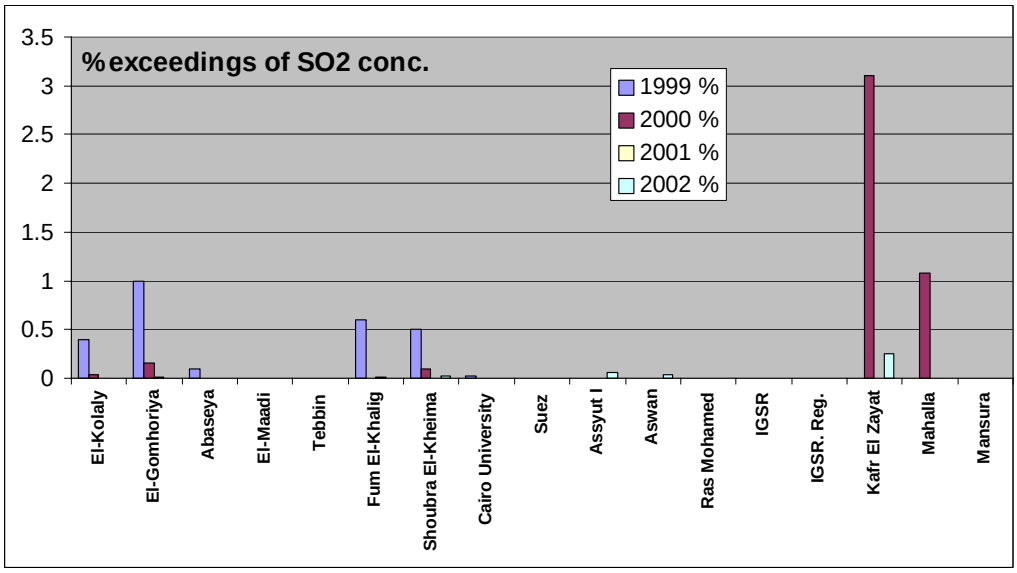


Figure 3: Exceeding (in %) of the one-hour average air quality limit value for SO_2 given for 17 sites in Egypt, 1999-2002.

In 1999 and 2000 five sites exceeded the limit values, in 2002 four sites experienced exceedances. In 1999 and 2000 the frequency of exceedances were higher than in 2002.

However the critical averaging time in air pollution of Egypt is not the one-hour averages. Diurnal and long-term averages such as monthly and annual average concentrations are more frequently exceeded

Figure 4 below shows an example the three-year averages of SO_2 concentrations measured at 28 different sites in Egypt. Three sites exceeded the annual limit value of 60 µg/m^3; KomOmbo, Quolaly and Shoubra ElKheima.

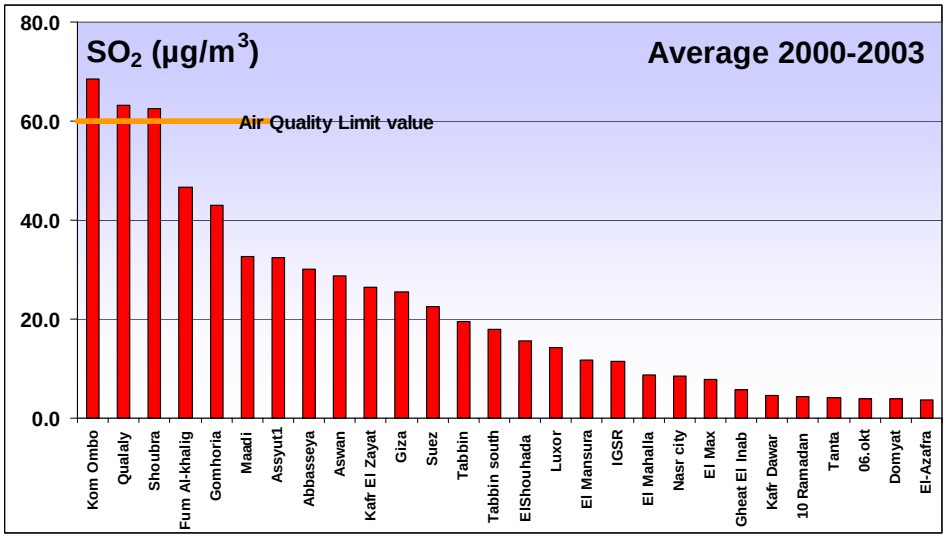


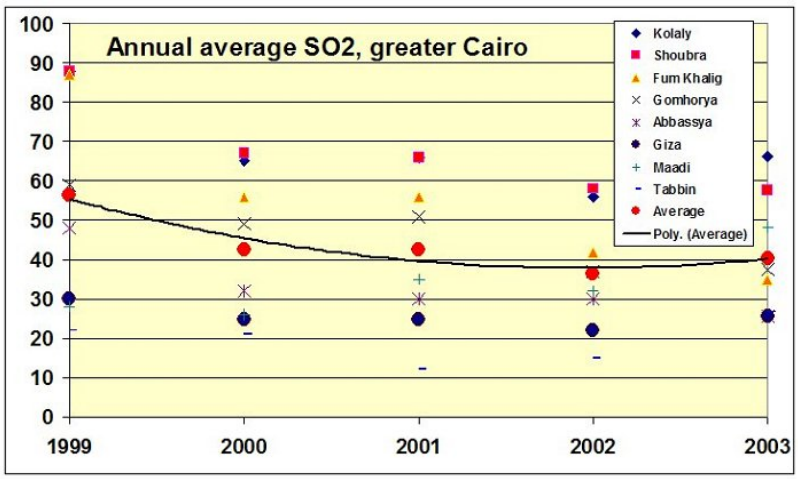
Figure 4: Long-term average concentrations of SO_2 (January2000-December 2003) measured at 28 sites in Egypt.

The sites located inside the city centre of Cairo had the highest concentrations of SO_2. As a comment to the sequential sampler deficiency it can be seen that except for typical industrial sites such as KomOmbo and Tabbin South the ten lowest concentrations are all measured using sequential samplers.

4.8 Newsletters

Several newsletters have been produced by the EIMP air component during the Phasing-out Phase of the project.

As presented in Mission report 04 the SO_2 concentrations measured by automatic monitors in the greater Cairo area during the last 5 years has revealed that the SO_2 concentrations in 1999 were slightly higher than in 2003.



However, from 2001 till 2003 there have been no significant changes in the average long-term concentrations of SO_2 in the greater Cairo area.

The newsletters will be printed in colours and distributed. As it proved difficult to have this task undertaken at EEAA, NILU will print all newsletters and distribute them to EIMP office at EEAA.

5 A national air quality monitoring system

EEAA has expressed a need for a comprehensive assessment of the overall requirements for establishing a complete national air quality-monitoring network for Egypt. This request has been addressed and included as part of the Phasing Out Phase of the EIMP programme.

A separate report has been produced which includes a proposal for one integrated air quality network for Egypt (Sivertsen, 2004). The report presents a proposal for a future National Air Quality Monitoring Network for Egypt to be operated by EEAA. The proposal combines the two existing networks developed by the Danida funded EIMP and the USAID funded CAIP programme.

Input and comments given by the EIMP and the CAIP staff at EEAA as well as from the experts at the monitoring institutions at CEHM and IGSR have been included in this report. The main purpose of the air quality measurements will be to identify the possible exposure to the public and to people in general. To enable evaluation and assessments of air quality and to enable trend analyses a network of **fixed stations** is needed.

5.1 Priorities and questions

Prior to a meeting at the EIMP office on 5 October 2004 a memo was prepared to discuss some of the main objectives of a national monitoring network and to raise some questions to be discussed by the experts involved.

A best possible definition of the air pollution problem together with and analysis of available personnel, budget and equipment represents the basis for decision on the following general questions:

1. What spatial density of sampling stations is required?
2. How many sampling stations are needed?
3. Where should the stations be located?
4. What kind of equipment should be used?
5. How many samples are needed, during what period?
6. What should be the sampling (averaging) time and frequency?
7. What other than air pollution data are needed:
   - Meteorology,
   - Topography,
   - Population density,
   - Emissions,
   - Effects and impacts, etc.?
8. What is the best way to obtain the data (configuration of sensors and stations)?

9. How shall the data be communicated, processed and used?

Further discussion and proposals presented in the meeting were based on the air quality monitoring programmes already operated by EEAA. The memo is presented in Appendix E1.

5.2 The CAIP sites

Another input to the design of a future air quality monitoring system for Egypt is the evaluation and use of the PM sampling programme established by the CAIP project.

A summary of this programme is presented in Appendix E2. The sampling of suspended particles in air is undertaken using AirMetrics samplers every six day. The analyses of PM_{10} and $PM_{2,5}$ have been undertaken at the Institute for Geological Surveys. Monthly reports are being prepared, but are delayed by about 5 months. The analyses take 2 months to finalise. This "problem" is being looked into and would be solved if analyses were to be undertaken at EEAA.

The CAIP programme also operates 4 meteorological stations using simple Met1 instruments, which cannot be automatically transferred to a central database on a daily basis.

5.3 A National Air Quality Monitoring Programme for EEAA, Egypt

In the description of a National monitoring system we have tried to prioritise sites and locations. As presented in the report (Sivertsen, 2004) there are three categories of sites:

1. First priority stations with on-line transfer of data on a daily or hourly basis
2. Second priority sites composed of a mix of monitors and samplers, monitor data may be transferred to the central database every day,
3. Third set of pure sampling stations, manually operated and reported after analyses in the laboratories

A total of ten high priority stations will be operating on-line transferring data automatically to the central computer at CEHM and at EEAA. These ten stations will have to get first priority in the future system. QA/QC as well as calibrations and instruments will have to be available at all times.

The sites should be the following:

- ElQuolaly, Cairo city centre highly impacted by traffic
- FumAlKhalig, Cairo, traffic and general urban
- Abbasseya, Cairo, urban background/ residential
- Gomhoreya Street, Cairo, street canyon site
- Kaha, upwind from prevailing winds at Cairo
- ElShouhada, central Alexandria traffic and general activities
- KafrZayat, most polluted industrial site in Delta

The second set of air quality measurement stations will combine monitors and samplers. There will be a total of 13 sites of this kind. These sites include 4 ozone

monitoring sites as well as 9 other sites with monitors, which may all be transferred vie telephone lines to the central computer on a daily basis.

The last part of the total air quality measurement programme for EEAA and Egypt consists of 30 sampling sites of various composition and importance. The main core of this programme is based on sequential samplers for SO_2, NO_2 and soot (black smoke, BS) and AirMetrics type PM_{10} and $PM_{2,5}$ samplers. The most important part of these measurements will be to present a complete picture of the PM exposure in Egypt

The measurement programme for Cairo has been given special attention. This programme is presented in Figure 5 below.

Figure 5: Different types of monitoring and sampling stations proposed for the Cairo area.

In the area presented by the map in Figure 5 a total of 23 stations will be operated. From these there will be 6 on-line monitoring sites (first priority). Five sites will

have monitors and samplers from which the monitor data will be transmitted on-line. Another 12 sites will have only samplers.

5.4 Data transfer and databases

For every site there is a need for a data acquisition system (DAS) to receive the measurement values collected by one or several gas or dust analysers, meteorological sensors or other parameters. The retrieval of data will depend upon the type of equipment available at the sites:

- Automatic monitors with telephone lines
- Monitors without telephone lines
- Samplers for routine operation

Databases have been established at the Monitoring Institutions (CEHM and IGSR) and at EEAA. These databases occasionally need upgrading, and updated computers and hardware systems may also be needed.

To meet the future requirements of fast and on-line access to air quality data and assessments we have indicated that that EEAA should start preparing the tools for performing an air quality management planning system. The tools for such assessment and abatement strategy planning procedures are available.

At least a measurement database has to be established to store, retrieve and organise the measurements in a fast and organised formate. It should be possible to carry out various analyses on data stored in the database, such as statistical calculations and quality assurance tests. Data will also have to be viewed graphically and printed.

The database should contain information that enables an evaluation of the actual state of the environment and it includes data for establishing trend analyses, warnings and the undertaking of countermeasures in case of episodic high pollution. The most important and urgent module to be installed at EEAA is the air quality measurement database including the statistical models and the presentation tools.

The EEAA database should include:

- Data base structure
- Import/export of data
- Graphical presentation tools
- Database for storing measured data
- Data statistics and presentation tools
- Report generator
- User interface including integrated GIS

It has been suggested that the Norwegian developed AirQUIS system will include all elements needed by EEAA. A test version was provided to EEAA during the Mission to Cairo, as seen below.

5.5 The AirQUIS database tested by EEAA

The AirQUIS system was installed at the EIMP office at EEAA on 13 October 2004. The system is presently being tested at EEAA on one server provided by NILU.

As part of the discussions of importing data directly to AirQUIS, the IT experts at EEAA, as shown in Appendix E4, presented the System Manager data structure. A description of the status as well as possible solutions is presented in Appendix E5.

The system may in the future operate on up to eight PC clients. If such client installations are desired to make the system more available to the EEAA staff, the associated time costs and licenses should be discussed before a final agreement can be made. The possibilities of automatic data imports to AirQUIS will be discussed further.

6 Air quality management and planning

The development objective of the Air Component of the EIMP programme has been to establish detailed knowledge of the ambient air quality in Egypt for the relevant authorities to act to improve the air pollution situation in Egypt.

Part of it has been achieved through the establishment of a high quality environmental monitoring programme. The Monitoring Institutions (at CEHM, Cairo University) and at IGSR (Alexandria University) together with a trained team of experts at EEAA should be able to produce data series, which will constitute the basis for appropriate political actions to be taken.

When it comes to the tools for performing quantitative air quality planning and develop optimal abatement strategies the tools are not available. The limitations at EEAA are clearly revealed when management and impact assessment has to be performed. Presently there is a total lack of expertise that can perform air quality modelling related to the good quality data that are collected by the EIMP/EEAA monitoring programme.

6.1 Air quality management needs

The data available from the EIMP programme can be used for investigating the impact and results on the air quality of any random action taken (trend analyses). However, to plan actions in the most cost effective manner air pollution dispersion models and exposure models are needed at EEAA.

We have several times proposed that the monitoring programme, which was developed by the Danida funded EIMP programme should have a follow-up including air quality planning tools. These efforts will have to be designed in a new future programme for EEAA.

The best approach to meet the needs identified by EEAA will be to start preparing the tools for performing an air quality management planning and starting to prepare a master plan for air quality in Cairo based on quantitative methods. The key element in such planning tools is atmospheric dispersion models.

So far there has been a “wait and see” attitude to the problem from EEAA and from Danida. Other countries and large urban areas world wide is now combining the modern on-line monitoring systems with modelling capabilities, which enable them to identify and quantify the most cost-effective solutions to improve the air quality. If there were one city in the world, which would need such an approach, it has to be Cairo!

6.2 The AirQUIS assessment and planning tool for EEAA

As part of the future air quality monitoring, assessment and planning system for EEAA, we have proposed that the EEAA experts are being trained in using a system such as AirQUIS. The AirQUIS system, which was developed by the Norwegian Institute for Air Research (NILU) (www.NILU.no), is designed to handle a number of air pollution tasks and challenges. It is based on a Geographical Information System (GIS).

AirQUIS is presently being tested as an air quality database and assessment system at EEAA. The total system, if purchased by EEAA, also includes models for emission inventories and dispersion models of different kinds. The system has been provided to EEAA free of charge from NILU for 3 months. After that period, no later than 17 January 2005, EEAA will have to make a decision whether to purchase the total system, which include databases, GIS systems, statistical and numerical models and a GIS based data presentation tool.

In a meeting on 10 May 2003 NILU was asked to present a proposal for developing a complete integrated database and planning system for EEAA including a cost estimate for the different modules.

The AirQUIS system was described and a price offer was presented to EEAA in May 2003. The total AirQUIS system presented in the offer to EEAA contains a number of modules, which may be selected individually or as a total package. The modules contains:

- A Geographical Information System (GIS)
- Automatic Data Acquisition System (ADACS)
- Measurement data; from automatic and manual import
- Statistical and Graphical Presentation Tools
- Emission Inventory Database
- Emission Models
- Wind Field Model
- Atmospheric Dispersion Models
- Exposure Model

The price offer was given to EEAA again in March 2004.

7 Training needs assessment

The training of personnel at EEAA and at the Monitoring institutions at CEHM and IGSR has been a continuous process through the EIMP programme as well as during the EIMP Phasing-out Phase.

Needs of training has been identified during every Mission, and several workshops and seminars have been undertaken. However, most of the training has been based on the daily hands-on training as training by doing.

7.1 Seminar

The last seminar during the programme was conducted on 21 March 2004. This seminar was designed to update the participants on the air quality monitoring programme for Egypt established as part of the Danida EIMP programme developed for EEAA.

The seminar presented the measurement programme, some of the major results and discussed the background data as well as presented assessment of some of the results. The future air quality monitoring objectives and possible changes was also briefly presented. The seminar also presented the basis for air quality assessment and planning.

A collection of documents including the measurement programme description and the discussion of results was presented in the Mission 03 report (Sivertsen and Dreiem, 2004).

7.2 On-the-job training

On-the-job training related to the operations and maintenance of instruments as well as interpretation of data was followed up during Mission 05. The instrument maintenance and repair training was continued for the operators of the Monitoring Institutions ass well as for experts at the Reference Laboratory at NIS.

Training was also given to field operators as part of the Audits that were undertaken to a selection of monitoring stations.

8 Administrative work

Administrative work during Mission 05 has been based on questions from the EIMP/EEAA project manager. Some of the tasks have included discussions and memos concerning:

- Additional expert input to EEAA
- Development and use of Air Quality Indexes (AQI)
- QA/QC programme and the follow up at all levels
- Planning of the future air quality monitoring programme for EEAA
- Discussions with the EEAA forecast team
- The procedures for spare parts and storage of consumables

8.1 Additional expert input to EEAA

The expatriate team leader for the EIMP air quality monitoring programme was asked to identify the needs for a follow-up visit to ensure sustainability in the EIMP programme.

One important factor for ensuring sustainability is to assure and verify that the operators as well as the EEAA experts understand quality assurance, and is able to interpret the information that emerges from the data. This has been some of the main issues during the last Missions of the Phasing-out-Phase related to the Air Pollution Monitoring Component of the EIMP project.

We, however, still have a feeling that the training and development of new ways of storing, presenting, assessing and using the data is further needed. During the follow-up programme proposed in this Phase of EIMP we will suggest the following tasks and actions should be included:

1. Check instruments; repair whatever errors are still prevailing
2. Based on a prioritised programme covering Cairo as well as most efforts on on-line PM_{10} monitoring change and upgrade the programme to meet these needs
3. Verify that the QA/QC procedures at the Monitoring institutions as well as at the Reference laboratory are now fully understood and followed up
4. Perform training again to assure that the experts at all institutions including EEAA understand and can interpret the data
5. Prepare more newsletters (on paper in colours) to be widely distributed
6. Discuss other ways of data dissemination and spread of air quality information

7. Integrate all air quality data into one database and one programme for EEAA
8. Modify and improve the annual report to include trends, assessment and more discussions on potential source impacts

The follow-up mission will include a 3-week visit by the expatriate air pollution expert and two weeks visit by the instrument expert. The detailed Terms of Reference for this proposed additional input is presented in Appendix F1.

8.2 The access of spare parts from the storage

During Mission 5 most of the remaining spare parts were moved CEHM. However, parts such as Teflon tubes, needed to renew and clean up intake structures at existing stations was still in the storage. CEHM, who needed them, was refused by Haytham to get any of these.

It had been proposed that at least all parts made by rubber, such O-rings, paddings and linings, repair sets for pumps etc should be released to CEHM. The items arrived at CEHM, has not been verified at the end of our Mission.

CEHM should receive as soon as possible a detailed list of the remaining spare parts still available in the storage.

8.3 Meeting at End-of-Mission

In the meeting with the counterparts and with Ahmed Abou Elseoud at the end of the Mission several items were discussed, as mentioned above.

The EIMP Phase-out Phase has come to an end and several comments, advices and tasks could have been summarised at the last meeting. In Appendix F2 there is a summary of concerns, suggestions and tasks.

We have especially pointed at the daily and weekly QA/QC and data follow-up at the Monitoring institutions as well as at EEAA. Also “calibrations” and verifications performed at the Reference Laboratory at NIS do not seem to be followed up adequately from EEAA. Some mistakes and misunderstanding concerning calibration procedures has been revealed.

It is considered very important that the communication and co-operation between the three levels of the total monitoring programme is working well. To achieve good results and good quality data requires a positive atmosphere and communication as well as CO-OPERATION.

As responsible for the design, installations, some of the operations and training of the EIMP air quality monitoring programme it was a sad day for me to leave the programme for the last time. I sincerely hope that EEAA will make the programme sustainable in the future, and I will be available for any questions, comments or problems at any time. My mail address is. BS@nilu.no

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Appendix A

People and schedules

Appendix A.1: People and adresses (October 2004)

EIMP office,3 EEAA Building, 30 Helwan Str.Maadi, Cairo (behind Sofitel hotel) ,
Tel. 202 525 6474 ext. 7223, Fax: 202 525 6467, E-mail: eimp@intouch.com
Staff: Ahmed AlSeoud (EEAA. *tel: 0123102068, 5721289), aahmed_hm@yahoo.com*
Air: B Sivertsen (Task Manager), tel. 351 1615, Dreiem, Ahmed Abou Elseoud (AAE), Ashraf Saleh Ibrahim(ASI), , Khaled Hamdy (KH), Ayman El-Maazawy (AEM), Mohamed Awad Shendy(MAS), Al Shabrawy Mahmoud (SMI), Hossam El Shakhs (HS), Mohamed Kassem (MK), (In Germany: Haytham Ahmed (HAA(p: 320 2078)), Mai Ezz El din Ahmed (MEA)
CEHM / Cairo Univ, t el 571 9688, Fax; 571 9687: Dr Sharkawi, Dr. Mortallah, (Dr. Yehia Abd El Hady) Dr Tarek El Arabi (Project Manager) mob: *0123484050, TMELARABY@hotmail.com*
Staff:Ashraf Saleh (data retrieval), Dr. Essam Abdel Hallin (data retrieval), Mahir Sayed Hafez (Tabbin), Ahmed Sayd (Qualaly, Gemhoroya), Yassin Fathi (Giza CU, Fumm al Kahlig), Kamela (Mon.lab., Shoubra), Ahmed Sulamen (Chem lab head), Ameni Taher (Chem. Anal.).
IGSR Alex Univ, tel:03422 7688, lab: 03 422 5007, Proj. tel: 424 1485, Fax 203 421 5792 , Dr M El-Raey tel: 0*123109051 (elraey@cns.sisnet.net)*, Dr. El Sayed Shallaby, Shawkat K. Guirguis (QA) (*aplab@igsrnet.net*), Dr Zekry Ghatass, Ashraf A Zahran, Mohamed Rashad Hossam A Said, Heba Said,
Data Management: Jacob Andersen, Hossam ElShakhs, Ayman El-Maazawy, Mohamed Shendy
Coastal Water: Arne Jensen, Erling, Ole, Al Shabrawi Mahmoud
Reference Lab: Ulla Lund, (Street 13 Maadi) tel: 012 312 0951, Mai EzzEldin Ahmed (counterpart), Fleming Boysen,
EEAA,Dr. Mohamed Said Khalid (Chairman), Dr Mawaheb, Mrs Hoda Hanaffi (head of GIS),
Dr Mahmoud Nasrallah
Meteorological Authority (EMA): Dr. Ahmed Adel Faris (Deputy Chairman), Dr. Mohamed M. Eissa (Dir. Gen. Information), Dr. Rabiee El Fouly (Dir Gen. Research), Dr. M.A. Abbas (Dir Gen for Instruments and Laboratories),
Sofitel Hotel: Maadi, Tel: 526 06011, Fax: 202 526 1133
Ambassader: Norge: Al Gazira al Wusta str. Amassadør Bjørn Frode Østern. Vivi Heck 735 3340
Maadi: Oystein Rismyr 44 Road 20. Apt 4, 753 0007
Danmark: 12 Hassan Sabri, Zamalek, John Carstensen 378 2040
COWI: 00 45 45 97 22 11
Danida: Jørgen Simonsen, 21 Road 86/Mustafa Kamel, P: 358 6167, Mob: 012 214 1759
USAID - CAIP: Jim Howes, Monir Labib, Jennifer Baker (Training) , Kirk Stopenhagen
Mrs Ekhlas Gamal ElDin, Hani, Said, Mike Smith
CTS: Amr ElSoueini, tel: 378 2908, Fax: 350 4977, *Mobile: 012 216 6670*, Ali Hamed
EMC Bill Hayes, Steve Gersh (Vice President), Fax:805 544 1824, (sgersh@emcslo.com)
Mohammed Nasar (AQ) , tel 351 5174, Canal Street 3, Maadi
Giza Pyramids: Dr. Hawas, Ahmed El Hagar, **Sakkara**: Mohammed Hagras, Hamdi Amin
Saddam driver: 012297 189, **Ahmed drive**r: 010 113 7410, p:023296259
BS: Flat: no.4 103 Street, Mahmoud Taha, mob: 012 341 3899, priv. 5255743, leil. 2.etg. 5255955

Appendix A.2: Programme for Mission 05, September-October 2004

Mission 05, 18 September to 28 October 2004, includes the following items for
B Sivertsen (BS) (6 weeks),
R Dreiem (RD) (4 weeks) and
The Nguyen Thanh (TNT) (1 week):

- Site audits and audit report (RD)
- Inspect instruments and data transmission (RD)
- Check QA/QC procedures (BS/RD)
- Audit the operations of the Reference lab at NIS (RD/BS)
- Final on the job training in maintenance and repair (RD)
- Newsletters and summary reports (BS)
- Analyse air quality data, report episodes (BS)
- Train EEAA staff in data interpretation (BS)
- The AirQUIS database, install and train (TNT)
- Prepare input to State of the Art report, air quality trends (BS)
- Site evaluations, some site visits and prepare upgrading (BS)
- Design one national network and discuss an integrated programme (BS/RD)
- Prepare report for the proposal for ONE integrated national AQ network (BS)
- Final reporting to Danida, Final Mission report (BS)

The procedures from instrument via monitoring institutions to EEAA will be investigated in particular. QA/QC and data quality is a main issue, and a report on the functioning of the three levels, including the reference laboratory at NIS will be prepared.

A summary of the status of the network including operating instruments and needs for updating will be discussed and reported.

Appendix B

Status measurement program

Appendix B1: From Rolf Dreiem, 27 Oct 2004

Work notes October 2004.

1 Oct. 2004 Arrived Cairo in the afternoon from Norway.

2Oct. 2004 Reading memos and manuals. Briefing from BS about status on instruments in Cairo and Alexandria. Made appointment to go to CEHM and start working on all instruments in need for repair and calibration.

3 Oct. 2004 Had a short talk to Maher in office about the Minutes of meeting with CEHM, status air quality monitoring CEHM.
The objective was to discuss the overall situation of dust monitors and samplers.
In the afternoon I went to CEHM to get the status of all monitoring equipment aCEHM laboratory. Why it was there, how long it has been there and the plans to have the monitors back to work at stations. This is the responsibility of Ahmed.

4 Oct. 2004 Went to CEHM in the morning to meet Maher. We discussed in details all problems concerning PM10 monitors. How can we repair the dust monitors? How can we get spare parts? The dust samplers are easier to repair. The spare part list is given to CTS today. Hopefully CEHM will have these spare parts within 3 months. The timers on VOC samplers are not in use any more and they will be rebuilt by Maher to fit on high volume samplers.
Some pictures were taken of the photo diodes inside PM10 monitors. This picture was e-mailed to Mr Leif at NILU, Norway. He is also trying to find a supplier.

5 Oct. 2004 Worked with Ahmed to solve the problem on internal span on O3 monitors. NIS claim internal span, level 1 is 180 ppb. When testing on Ras Mohamed monitor level 1 gives 315 ppb. NIS is doing calibration and has full control of all steps in the procedure.
The plan was to make an ozone calibration curve with the help of a NOx monitor and a multipoint calibrator. In the end we saw that this did no work because of some malfunction in ozone generation power supply. This power supply is OK within a few weeks. I explained to Ahmed in details how this done. We also put it down on a paper. This power supply is used to generate ozone to check the efficiency of the NO2 converter. It is important to repair this unit before any NOx monitor is calibrated.

6-8 Oct. 2004 Not working day.

9 Oct. 2004 Office work. Prepared for visit to IGSR and the Delta. (3 days trip).

10 Oct. 2004 Went to Alexandria by train in the morning. Had to hire a taxi for the whole day to have transport from station to station. After a short meeting at IGSR, Heba and I made a station audit at **Alexandria background station.**

This station is well maintained by Heba. All files are in good order. Inside it is clean and nice. All meteorological sensors are missing. Maher is trying to by electrical connectors in Cairo before putting up sensors.

After making the forms I found Hossam and went **to El Shohada station**. The responsible for this station, Mohamed Rashad was absent.
El Shohada station have not been maintained in a good way.
Telephone line did not work.
No calibration done with working or travelling gas cylinders.
Working gas cylinders is at the station, but not used. Mohamed Rashad went to the station every week. The only work done was change filter on Air Metrics sampler.
New responsible for El Shohada station is Hossam.
For details see Station audit and Non-compliance 1-2-3 forms for this station.

11 Oct. 2004 Hired a taxi to have transport to stations in the delta. This car was at the same time used to transport travelling gas cylinders, monitors and samplers. IGSR do not have any car they can use in transportation of instruments. This makes delays in taking not working instruments to CEHM for repair and repaired instruments from CEHM to stations to start measurements.
At **Kafr EL Nasaria** the passive sampler is placed in a corner between 2 bricks.
After doing this no passive sampler has been lost.

At **El Mahalla** only dust fall is in operation. For details look in Station audit report. Modem was taken from Mahalla to Kafr Zayat.

The shelter at **Kafr Zayat** station is in very bad condition. It has rust holes on the roof and sides. The grab rails on the roof have rusted away. The grab rails are fastening points for air intakes and must be renewed as soon as possible. This is also for the safety of the operators.
Installed modem from Mahalla.
Installed SO2 monitor from CEHM, delayed several weeks in transportation
(No useful car at IGSR).
Made calibration by travelling standard on NOx and SO2 monitors.
Made Station audit. For details look in Station audit report.
At Kafr Zyat station there is a risk of destroying all instruments by rain if the shelter is not repaired.
Stopped at Kafr Dawar station to pick up SS sampler. The sampler is not working, as it should. One repaired Air Metrics sampler was

programmed and started. This sampler comes from CEHM after repair.
Driving back to Alexandria in the evening. (Taxi).

12 Oct. 2004 Made Station audit at **IGSR station**. For details look in Station audit report.
Leak on air inlet on PM10 monitor. This monitor will be destroyed if rain comes along air inlet and inside the monitor.
Had a meeting with Side Shalaby and Hosam.
Discussed Station audit reports and Non-compliance reports.
SS signed all Non-compliance reports and I went back to Cairo on the evening train.

13 Oct. 2004 Preparing audit reports in office.

14–15 Oct. 2004 Not working day.

16 Oct. 2004 Made Station audit at **Ghomoraya Street** together with Madame Camela.
Made Station audit at **Abbasya** together with Madame Camela.
Made Station audit at **Fum El Khalig** together with Madame Camela.
Fum El Khalig has alarm on pressure, NOx monitor. Repair is needed within one week. For details look in Station audit report.

17 Oct. 2004 Office work. Making Station audit reports.

18 Oct. 2004 Station audit at **Tebbin** station.
All monitors are working.
For details look in Station audit report.
Went to laboratory at CEHM.
Status SO2 monitors today: All monitors are working except Mahalla.
Mahalla SO2 monitor is at CEHM for repair.
Maher can put internal modems in station computers. Cost is 50-60 LE.

19 Oct. 2004 Vent to NIS in the morning. Ahmed came from CEHM with one ozone monitor from Abasya. He also had NOx monitor from CEHM.
Started all instruments listed below:

- NOx monitor CEHM.
- NOx monitor NIS.
- O3 monitor Abasya.
- O3 monitor NIS.
- Calibrator multipoint NIS.
- Calibrator ozone NIS.

Warm up time before calibration is normally “overnight” on all instruments.
Discussed calibration work at NIS and CEHM.
An agreement was made between NIS and CEHM.

CEHM is first doing calibration. As soon as possible the monitor is transported to NIS for verification of CEHM calibration. NIS is using Multipoint calibration form. On sheet 2 the word verification is used instead of calibration.

All calibration and verification this year is delayed work from 2003.
NIS did not have calibration gases before March 2004.

20 Oct. 2004 Went to NIS in the morning.
Started to calibrate O3 and NOx. Made 800 ppb NO on multipoint calibrator.
Started also to calibrate O3 monitor. Calibration of O3 monitor went on well.
There was no problem in O3 calibration.
Response at 800 ppb NO were as follows:
CEHM: 670 ppb
NIS: 480 ppb
NIS said this happens some times, only half response on NOx monitor.
Removed Teflon filter on 800 ppb calibration gas. No response on monitors.
Suddenly the **NIS monitor** jumps up to **1180 ppb** and remained stable.
The CEHM monitor was stable at 680 ppb.
This result gives no meaning and we shut down calibration for the day.
Both NOX monitors were taken to CEHM. Ozone monitor had a new certificate and is going back to Abasya.

21-22 Oct. 2004 Not working day.

23 Oct. 2004 Made Station audit ay Quolaly.
All instruments but TSP is working.
For details look in Station audit report.
Made Station audit reports in office.

24 Oct. 2004 Went to CEHM in the morning. Worked with calibrator, NOx monitor and gas phase titration. Calibrator ozone generator is repaired last week.
Trained Ahmed to make ozone calibration curve and converter check on NOx monitor.
Explained in details how to use an open-end filter holder. As pump and flow control unit a SS sampler and flowmeeter is used (Maher).

25 Oct. 2004 Went to NIS in the morning.
Tested the calibration system.
We used one SO_2 monitor from CEHM and one SO2 monitor from NIS.
Here are the results:

Reference	NIS monitor	CEHM monitor
800 ppb	799 ppb	755 ppb
600 ppb	599 ppb	560 ppb
400 ppb	396 ppb	386 ppb
200 ppb	193.7ppb	182.8 ppb
0 ppb	1.1 ppb	0.9 ppb

Average difference is 6 %. This is within limits considering 2 different calibration systems have been used.
We learned from this that the **calibration systems at NIS and CEHM are working well.**

The difficulties reported on 20 Oct.2004 may be due to the following:

1. **Gas lines at CEHM or NIS are dirty and absorb NO gases.**
2. **Certified 101 ppm NO gas at CEHM or NIS is not 101 ppm any more.**

1 and 2 can be verified by checking both NO and SO2 cylinders on NIS calibrator.

There might a bad connection in NOx monitor at NIS.
When a monitor shows 60% of expected value, something is wrong (480 ppb).
When calibrated from 460 to 800 ppb the result is 1150 ppb if the monitor is doing correct measurement.
There is no reason to calibrate a monitor from 60 to 100 %.
If a monitor is far out fro expected value

27 Oct. 2004 Office work.
Last working day. Leaving Egypt 29. Oct. 2004.

Appendix B2: Minutes from meeting with CEHM

Date: **21 September 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed, Ashraf Saleh Ibrahim, **Tarek El Arabi**
From: **Bjarne Sivertsen (BS)**

Status air quality monitoring CEHM, September 2004

Introduction and agenda

The main objectives of the meeting were to discuss the status of the programme (in brief) and to prioritise the future air quality monitoring programme for Egypt. The following agenda was presented:

1. Discuss the last quarterly report from CEHM
2. Check sequential samplers SO2 concentrations again
3. PM10 monitors – problems and priorities
4. General discussion on instrument status
5. QA/QC and the co-operation with NIS
6. Future monitoring programme, ideas and priorities
7. Daily reporting, data requirements
8. Server problems at CEHM to be solved soon

Discuss the last quarterly report from CEHM
The Quarterly Report for the second quarter 2004 has been prepared and evaluated by B Sivertsen. Some comments were made concerning the quality control of the report. Dr Tarek stated that this at the end is his responsibility.

Also some mistakes and understanding as well as mistakes in presenting sequential sampler data were presented. All these “errors” will be corrected before a final report will be issued.

Also the discussions and the conclusions presented in the report were discussed. It was requested that the final summary and conclusions were developed more as an overview, and not just repeating what has been said earlier in the report..

Check sequential samplers SO2 concentrations again

The problem of measuring too low SO_2 values from the use of impregnated filters in the NILU sequential sampler have been discussed at several occasions, and some of the reasons have been summarised in a memo (19 September 2004), which was handed to CEHM.

If the intake structures have not been cleaned and the intakes are dirty SO_2 entering the intake system as SO_2 may react with alkaline dust deposited in the intake tube and SO2 will not reach the impregnated filter. The operators have to clean intakes properly!

The impregnated filter also need to be “wet”. It may dry out if the humidity of the air is “lost” during very dry conditions. The addition of glycerol to the

impregnation solution is meant to minimise this problem. The efficiency of the impregnated filter could be controlled by placing a 0.3% H2O2-absorption solution behind the filter holder and analyse the exposed solution for SO4 by ion chromatography.

PM10 monitors – problems and priorities

The on-line continuous measurements of PM_{10} (as an indicator for suspended particles in air) are first priority in the air monitoring programme for Egypt.

Two types of monitors are being used; the old Wedding type and a newer Eberline type PM_{10} monitor, both based on beta attenuation. A total of 9 PM_{10} monitors have been installed in the programme. Most of them are still working, but the possibility for total break down is considered. One main problem is one specific part of the old Wedding instruments, which cannot be produced any more by the instrument provider. This optical coupler (like a photo diode) is not available according the CTS. We will check again with Thermo in the Netherlands what the status is.

The status of the PM_{10} monitoring programme is:

- Quolaly: working
- Tabbin working
- FumAlKhalig working but with modifications on the missing part
- ElMahalla working?
- IGSR working based on an Eberline taken from Kaha. This will be moved to Kafr Zayat on request from IGSR.
- Kaha A Wedding instrument has been installed in Kaha, not working properly
- Kafr Zayat No instrument, One Eberline monitor been at CTS for one year
- Assyut No instrument, at CEHM?

One instrument is at CEHM calibration laboratory.
CEHM has requested a maintenance manual from CTS several times, but has not received it. CTS do not want to give it away?

General discussion on instrument status

Several monitors were reported out of order, at calibration or at repair. Some NO2 monitors were missing a spare part that has not been ordered (photo multiplier). CEHM was requested to present a complete spare part list for ordering through EEAA. This list will have to be at EEAA before 26 September 2004.

The following status was presented as of 21 September 2004:

Station	Parameter	Comment	Reason	From date:
Aswan	all	Phone down	Line out	9 Sep 2004
Tabbin	WS SO_2	Abnormal Readings between 6.0 and 6.9 only	Cleaning ???	1 July 2004 1 Sep 2004
Kaha	PM_{10} NO_2 Ozone	Reading between 32 and 33 only Closed. Monitor at CEHM Zero every day from 19:00 till 10:00	?? Spare parts ???	20 Sep 2004 1 July 2004 16 Sep 2004
Maadi	NO_2 SO_2	Closed for repair Closed for repair	Spare parts Repair	19 Aug 2004 1 July 2004
Shoubra	all	Phone connection down	Line error	20 Sep 2004
Abbaseya	SO_2	Readings between 3.0 and 3.9 only	???	20 Sep 2004
Giza	SO_2	Closed due to repair	Repair	12 Sep 2004
Suez	all	Station transferred	Phone not installed	12 May 2004
Ras Moh	Ozone	Monitor at CEHM, will be returned on 1 Oct.	repair	?

QA/QC and the co-operation with NIS

On request concerning the co-operation between NIS and CEHM on an operational level, Tarek answered that this work is positive. NIS operates as a reference laboratory and the monitoring laboratory at CEHM in general find the system positive.

Only minor problems and misunderstandings occasionally bring up a problem. CEHM hope to discuss these in a Reflab seminar on 28 September 2004. After CEHM has calibrated the monitors it is the Reflab obligation to verify the calibration. If discrepancies are identified, these have to be reported back to CEHM. NIS should not recalibrate and change the settings in the instruments without any notifications to CEHM. This problem has led to errors on the monitoring stations, and has in one case resulted in a non-compliance report, which actually was an error from NIS!

The transfer of gas cylinders is working well. CEHM, however, still is missing fittings as reported in March 2004. Also, as reported by Ulla Lund, the Reference Laboratory is urged to follow the concentration in the travelling gas cylinders closely to make sure that monitors are compared to correct concentrations.
The communication between NIS and CEHM could have been improved.

Future monitoring programme, ideas and priorities

An initial discussion and feedback from CEHM concerning the design of a future unified air quality monitoring programme for EEAA gave some valuable comments to the situation.

Dr. Tarek questioned the use of the data that the EIMP programme is collecting. What about the air quality assessment? Do we just collect data and store them away for no use? From CEHM point of view they would like to see forecasts, predictions, abatement evaluation and strategies to reduce pollution.

Annual reports should identify whether any action taken are reflected in the air quality. How often do we have exceeding of limit values, where are they and what are the reasons?

For a more optimal use of the data modelling and emission inventories should have been introduced, especially for the case of greater Cairo area.

Are there needs for introducing other air pollutants, such as hydrocarbons, toxic pollutants and maybe BTX? Industrial areas should be covered better. The residential area measurements in places such as10 Ramadan and 6 October could be moved to more polluted areas.

Priorities have to be put on on-line monitoring in Cairo. Merging the CAIP developed network into the integrated future programme will only give information e.g. one month after the measurements have been collected in field.

Daily reporting, data requirements

CEHM was informed about the new procedures, which are being developed at EEAA concerning daily reporting of air quality in Cairo. Four sites have been selected for this reporting especially;
Quolaly, FmAlKhalig, Gemhoreia Street and Abbaseya.
For these sites we will try to generate an air quality index (AQI). It is thus of utmost importance that data from all monitors at these sites are available every day. Data from the following sites will be presented in a table such as shown below:

Day: 3 May 2003	***Max. 1 hour average concentrations last 24 hours ($\mu g/m^3$)***				
Site	***SO_2***	***NO_2***	***PM10 (24 h)***	***Ozone***	***CO***
Kaha					
Shoubra El-Kheima					
Abbaseya					
Gomhoria					
Quolaly					
Fum AlKhalig					
Maadi EEAA					
Tabbin					

EEAA will thus put priority on the measurement programme for Cairo, especially linked to the on-line part of the programme (monitors). First priority compound also seem to be the PM_{10} monitors (see above discussion).

Server problems at CEHM to be solved soon

CEHM have experienced server problems for a long time. They are presently only operating on the back up server. This is the reason for the transfer of final data to the database at EEAA has not been operated since mid July.

The computer (server) is presently in the office at EEAA. Necessary spare parts and additional RAM has been purchased. Maher will pick up the computer and install the additional pieces on 22 September from 12:00 hours.
The server should thus be working again from next week.

Appendix B3: Memo

Environmental Information
and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **24 October 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed (HAA), Ashraf Saleh Ibrahim(ASI)
From: **Bjarne Sivertsen (BS)**

Instruments operating October 2004-10-21

A number of monitors and samplers were identified out of operations in October 2004. There were several reasons for these break downs:

- At CEHM for repair
- Missing spare parts, ordered
- Crucial part not available
- Instrument out of data (dead)
- Unknown failure, instrument stalled

The following table summarises the monitor status.

Para meter	Working monitor	N	Not working	N	Tot
PM_{10}	Quo, Tab, Abb, Fum, Kah	5	IGSR, KaZ, Ass, Mah	4	9
NOx	Gom, Tab, Fum, CaU, Sho, Suez, KaZ	7	Quo, Mad, Kah, Ass, Man, IGSR?	6	13
SO_2	Quo, Gom, Abb, Tab, Mad, Fum, Suez?, IGSR, Sho, KaZ	10	Sho, CaU, Ass, Asw, Mans? Mah?	6	16
O_3	Abb, Asw, Ras, IGres	4	Kah, CaU?	2	6
CO	Gom, Fum, IGS	3			3
met	Ab, Tab, Asw, Mans?	4	Kah, IGres	2	6
	Total avail. monitors	**33**		**20**	**53**

As can be seen in the table only 33 monitors out of a total of 55 were operating in field in medio October 2004. This means that 38 % of the monitors were NOT in operation.

This is not very satisfying, even if many of the monitors are reaching their lifetime expectancy.

Appendix B4: Meeting with IGSR

Environmental Information
and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Minutes from meeting with IGSR

Date: **26 September 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed, Ashraf Saleh Ibrahim, Rolf Dreiem, ElSayed Shallaby
From: **Bjarne Sivertsen (BS)**

Status air quality monitoring IGSR, March 2004

Introduction and agenda

The main objectives of the meeting were to discuss the status of the programme and sicuss weaknesses and possible changes needed to optimise the programme. The following agenda was presented:

1. Discuss the last quarterly report from IGSR
2. Check sequential samplers SO_2 concentrations again
3. PM10 monitors – problems and priorities
4. Additional use of PM_{10} samplers
5. General discussion on instrument status
6. QA/QC procedures, data transmission and updates
7. Future monitoring programme, ideas and priorities

Discuss the last quarterly report from IGSR

The Quarterly Report for the second quarter 2004 has been prepared and evaluated by Ashraf and Haytham. Oral feedback had been given to IGSR and the report has been sent in final form to EEAA.

Te data availability due to instrument failures have not been satisfactory. This can be easily understood from the discussions below. Also the text and interpretations in the report has not changes much since earlier reports, and the quality assurance of the final product could have been better.

The discussions and the conclusions presented in the report have been discussed earlier, and it will strengthen the product if the assessment of the air quality had been more detailed. There are data that would need better analyses and understanding.

Check sequential samplers SO_2 concentrations again

The problem of measuring too low SO_2 values from the use of impregnated filters in the NILU sequential sampler have been discussed at several occasions, and some of the reasons have been summarised in a memo (19 September 2004), which was handed to IGSR. The matter was discussed with CEHM last week, and the staffs of IGSR wants to follow-up and study some of the possible reasons for the measurements of very low SO_2 concentrations especially in Alexandria and the Delta.

An investigation using all kinds of monitors and samplers at one site e.g. El Shouhada or IGSR will be undertaken. We also discussed the possibility of bringing one EMEP sampler (filter outside shelter) to Egypt and study the difference between the EMEP and the SS sampler.

PM_{10} monitors – problems and priorities

The on-line continuous measurements of PM_{10} (as an indicator for suspended particles in air) are first priority in the monitoring programme for Egypt.

Two types of monitors are being used; the old Wedding type and a newer Eberline type PM_{10} monitor, both based on beta attenuation. A total of3 PM_{10} monitors have been installed in the programme operated by IGSR. Only one of them is working as of 26 September 2004.

Most of them are still working, but the possibility for total break down is considered. One main problem is one specific part of the old Wedding instruments, which cannot be produced any more by the instrument provider. This We will check again with Thermo in the Netherlands what the status is.

The status of the PM_{10} monitoring programme is:

- IGSR — The monitor was for repair at CEHM from November 2003 till 15 August 2004. It is now working well and is an Eberline monitor taken from Kaha. It may be moved to Kafr Zayat after decisions taken on 5 October 2004.
- Kafr Zayat — No instrument available. The monitor has been at CEHM for a long time. A spare part is missing. It may be the optical coupler, which we have checked with Thermo and which is not available any more.
- ElMahalla — Pm10 working but need upgrading and should probably have been to CEHM for repair. Data available till August 2004. Could be the same problem as for Kafr Zayat. (Rolf should check).

Additional use of PM_{10} samplers

Two types of samplers; High volume and AirMetrics also measure PM_{10} concentrations. As long as on-line data is not required this will give important input to the monthly, quarterly and annual reports.

It is thus important that these samplers are working. More AirMetrics samplers may in the future be taken from the CAIP programme and moved to sites in the Delta if this is required.

PM_{10} high volume samplers are being operated in:

Gheat ElEnab:	working well
ElMax	The old sampler is for repair. The sampler at ElNahda will be moved to ElMax and set in operation from this week
Damietta	The sampler is at CEHM for repair (controller)

PM_{10} AirMetrics samplers are being operated at:

ElAsafra	Sampler at CEHM for repair (charger)
ElShouhada	Working well
Tanta	Working well
Kafr Dawar	Sampler at CEHM for repair (charger)
Damanhour	Will be installed at new site before 1 October

General discussion on instrument status

A number of monitors were reported out of order, at calibration or at repair. The programme operated by IGSR is totally missing about 8 instruments. Most of them are out of order or have been at CEHM for repair for a long time.

The meteorological station at IGSR has also been out of function for a long period. Sensors have been taken to CEHM. New sensors from the store have to be installed as soon as possible.

EIMP Monitoring and Sampling Program Status, IGSR, 26 September 2004

I.D	Alexandria Sites	Area type	Param	Status	Responsible	Comments
28	**Abu Qir**	Industrial	SO_2(PS) NO_2 (PS) NO_2 (SS)	Ok Ok Ok	M. Rashad	
29	**El-Max Petrogas**	Industrial	SO_2 (SS) NO_2 (SS) PM_{10} (HV) DF	Ok no -- Ok	M. Rashad	- NO_2 from CEHM, will be installed this week PM_{10} hivol will be installed instrument from Nahda)
30	**IGSR, Alex**	Urban	NOx (M) SO_2 (M) PM_{10} (M) CO (M) SO_2 (PS) NO_2 (PS)	OK Ok Ok ? Ok Ok	Heba Said.	CO reactor still need repair.
31.	**El-Asafra-**	Residential	SO_2 SS PM_{10} (AM) SO_2 (PS)	OK no Ok	M. Rashad	AirMetrics at CEHM, Needs charger (Hossam).
32	**Gheat El-Inab**	Residential	SO_2 (SS) NO_2 (SS) PM_{10} (HVS)	OK OK OK	M. Rashad	
33	**Alexandria regional**	Regional	Met Ozone (M)	-no Ok	Heba Said	Met Parameters (sensors) have been sent to CEHM for replacement.

I.D	Alexandria Sites	Area type	Param	Status	Responsible	Comments
41	**El Nahda**	Industrial Semi urban	DF	Ok	M. Rashad	
42	**El-Shohada Square**	Traffic	SO_2 (M) NO_2 (M) PM_{10} (AM) SO_2 (PS) NO_2 (PS)	? Ok Ok OK OK	M.Rashad	Some questions about SO_2 readings

	Delta Area	Area type	Param	Status	Responsible	Comments
34	Damanhour	Urban	PM_{10} (AM) SO_2 (PS) NO_2 (PS)	--- --- ---	Mourad	- The building in about to be ready. Instruments will be installed before 1 October
35	Kafr El Zayat Kafr Elnasrya	Industrial/res.	SO_2 (M) NO_x (M) PM_{10} (M) DF SO_2 (PS) NO_2 (PS	no ? no OK Ok Ok	Mourad	SO_2 monitor sent to CEHM for repair NOx installed today, from calibration at CEHM, flow sensor give zero, pump working - PM_{10} still at CEHM for repair.
36	Tanta	Urban	SO_2 (SS) PS (N) PM_{10} (AM)	Ok Ok Ok	Mourad	
37	El-Mahalla	Industr/res.	SO_2 (M) PM_{10} (M) DF	--- --- OK	Mourad	- SO_2 monitor at CEHM for repair. -PM_{10} Needs repair.
38	El-Mansoura	Industrial/res.	Met NOx (M) SO_2 (M) DF	Ok Ok ? Ok	Ashraf Zahran	Roof of El-Mansoura shelter needs repair. - SO_2 monitor returned from CEHM after calibration. N.B. temp, R.H., net radiation needs cup.
39	Damietta	Urban/reside	SO_2 (SS) PM_{10} (HV) NO_2 (PS) DF	OK no Ok Ok	Ashraf Zahran	PM_{10} controller sent to CEHM. For repair on 6 Nov. 2003
40	Kafr Dawar	Urban/Indust	SO_2 (SS) PM_{10} (AM) SO_2 (PS) NO_2 (PS) DF	Ok no Ok Ok Ok	H. Ahmed	PM_{10} AirMetrics sent to CEHM for repair on 6 Sep. 2004.

QA/QC procedures, data transmission and updates

On request it seems that the data quality assurance is not as tight as originally designed. Data are studies based on graphical displays only once a month. These procedures should have been weekly. This means that the communication between EEAA experts who look at on-line data every day and IGSR has to be improved. The IGSR quality responsible person also has to go through the data every week at least.

The data retrieval from monitors is working satisfactory. However, data from IGSR Regional and from El Shouhada has to be retrieved by diskettes. The monitoring

station at ElShouhada needs a modem. Also check the possibility of retrieving meteorological data (when the sensors have been repaired) and ozone from IGSR regional.

As we consider these two sites, together with Kafr Zayat, important for the daily information of air quality in Egypt, we have proposed that modems have to be operating at these three sites. Will it be possible to find the right type of modems for the old Station Managers? Check with Ayman? Maybe the Station Managers have to be modified. Did Jacob check? What is the conclusion with EMC? We could also take the modems from ElMahalla and IGSR to Kafs Zayat and ElShouhada respectively.
Also we want ElMansoura to work perfectly.

Future monitoring programme, ideas and priorities

An initial discussion and feedback from IGSR concerning the design of a future unified air quality monitoring programme for EEAA gave some valuable comments to the situation.

Dr. Sayed Shallaby mentioned that all stations are not representative, and that there are areas in Alexandria especially, which experience higher air pollution than measured at some of the EIMP sites.

The team at IGSR has suggested:

- Move the site at El-Asafra shelter to another site such as El-Awaid or another site near the airport, which they believe is exposed to high levels of air pollution. We have considered the Municipal Work Authority area a good site.
- The instruments at Abu Quir should be moved westwards to be downwind from paper companies at El Tarh. The fertilizer industries at Abu Quir have been cleaning up and reduced the emissions.
- The dust fall measurements at El-Nahda could be moved to other site.
- In the Delta we should consider the location of the site at ElMahalla again. We have found a site inside the city centre. Could this be used?

It was also mentioned that some of the shelters need repair. The SO_2 concentrations measured by the sequential samplers (SS) still seem to be too low. We should add measurements of sulphate. This will be undertaken as a test by IGSR. If there are still discrepancies between the SS and monitors, we have to consider replacing some of the SS. In the future it is recommended measuring sulphate on a routine basis at some selected sites where SO_2 is already measured to follow up the fate of SO_2 in the atmosphere.

IGSR also recommended carrying out analysis of selected elements in total suspended matter or particulate matter less than 10 micron. Particulate matter could be causing health hazards especially as carriers of toxic compounds.

In the southern Alexandria area there is a need for measuring H_2S on a routine basis. High levels of H_2S are expected at several sites. IGSR recommend measuring H_2S near the International Garden and the Airport. This will require a new SO_2 / H_2S monitor at this site .The main objective is to assess control measures taken to reduce the nuisances and complains from H_2S odours and its impacts in the area

Appendix B5: Memo

Environmental Information
and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **5 October 2004**
To: Ahmed Abou Elseoud (AAE), Danida
Copy: Haytham Ahmed (HAA),
From: **Bjarne Sivertsen (BS)**

The need of upgrading the PM monitoring system in Egypt

Introduction

The EIMP air pollution monitoring programme 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:

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

A result of the assessment of air quality in Egypt has shown that particulate matter (PM) is the most critical air pollutant. The EIMP programme has concentrated most of the efforts on measurements of PM_{10} as an indicator for PM. We also have seen the importance of on-line information, which will require that some of the instruments used will have to be automatic monitors reporting data on telephone lines to a central laboratory or to EEAA. Also manually operated PM instruments are used in the system.

The normal lifetime of air quality monitors that are being used in the EIMP programme is between 5 and 10 years. This implies that many of the monitors that have been installed since the end of 1997 till 1999 already are reaching the end of their normal lifetime.

In the following discussions we have roughly evaluated the highest priority needs for the coming years, and presented a cost estimate for upgrading the most

necessary instruments. A plan for redesigning the whole programme is being prepared for presentation at the end of October 2004.
The backbone of obtaining good quality air pollution data is linked to sustainability. As stated in my memo dated October 2000 on " A sustainable air quality measurement programme for Cairo", and further evaluated and cost estimated in a memo dated 16 March 2004 (Mission 04 report EIMP Air, NILU OR 50/2004, Appendix E1) 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 total annual costs for keeping up the existing air monitoring programme were estimated at 2.2 million LE.

Instruments and lifetime

The design, development, construction and installation of the EIMP measurement programme started in 1997 and were completed in July 1999. The Centre of Environmental Hazard Mitigation (CEHM) at Cairo University and the Institute of Graduate Studies and Research (IGSR) at Alexandria University are operating on behalf of EEAA, a total of:

- 14 sites located in Greater Cairo area,
- 8 sites in Alexandria area,
- 7 sites in Delta,
- 3 sites in Canal area and
- 10 sites in Upper Egypt and Sinai

The total programme include more than one hundred instruments in field at any time, consisting of:

- 46 automatic monitors for SO_2, NOx, PM_{10}, O3, and CO,
- 26 AirMetrics and Hivol PM_{10} samplers
- 14 sequential samplers for SO_2 and NO_2
- 5 High volume samplers for TSP
- 18 dust fall collectors
- 8 Automatic Weather stations
- A number of passive samplers (flexible)

From the last meetings with the Monitoring Institutions we have seen that some of these instruments are meeting their lifetime expectancies. More expensive parts will have to be changed and some instruments need major repairs.

To keep up the quality in the monitoring system, as well as assure sustainability we will have to propose that instruments are gradually replaced with new instruments. 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.

Instrument upgrading

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. We will return to these options in the proposed future National Air Quality Monitoring and Assessment Programme (NAQMAP) for Egypt.

We will also propose to move gas monitors around in the system to assure that the most interesting and most impacted areas receive the attention needed. For the PM_{10} monitors, however, an urgent need for upgrading the instrument park has been demonstrated. The background is that the on-line continuous measurements of PM_{10} (as an indicator for suspended particles in air) are now considered the first priority in the air monitoring programme for Egypt.

Two types of monitors are being used; the old Wedding type and a newer Eberline type PM_{10} monitor, both based on beta attenuation. A total of 9 PM_{10} monitors have been installed in the programme. Most of them are still working, but the possibility for total break down is considered. One main problem is one specific part of the old Wedding instruments, which cannot be produced any more. This optical coupler (like a photo diode) is not available according the instrument providers at Thermo Environment Instruments.

The status of the PM_{10} monitoring programme as of 1 October 2004 is:

Site	**Instrument**	**Status**
Quolaly:	Wedding	Working
Tabbin	Wedding	Working
Abbasseya	Wedding	Working but need photo diode soon
FumAlKhalig	Wedding	Working but need photo diode soon
Kaha	Wedding	Not working properly
ElMahalla	Wedding	Working but need to be checked
Kafr Zayat	Wedding	Not working
Assyut	Wedding	Not working (at CEHM)
IGSR	Eberline	Taken from Kaha. This will be moved to Kafr Zayat on request from IGSR
Lab station	Eberline	Not working, monitor been at CTS for one year

Out of 8 Wedding instruments 2 are working properly, 3 are working but with the possibility of breaking down soon. Three instruments are not working as of 1 October 2004. Only one of the Eberline monitors is working.

The needs for PM_{10} monitors includes at least 10 monitors on-line operating properly with adequate QA/QC and calibration procedures. Also necessary consumables and spare parts have to be made available.

The sites to be covered by PM_{10} monitors are as seen to day:
Quolaly, Abbasseya, FumAlKhalig, Tabbin, Kaha, ElShouhada, Kafr Zayat, ElMahalla, Assyut, the lab. We may reach another detailed conclusion after the final evaluation and proposal for the future programme. However, at least the 10 instruments mentioned should be available.

This means that at least 5 PM_{10} monitors will have to be purchased within the near future. These will replace the monitors that already have broken down.

Database and data assessment

Databases have been established at the Monitoring Institutions (CEHM and IGSR) and at EEAA. These databases occasionally need upgrading, and updated computers and hardware systems may also be needed. The costs for upgrading have not been implemented from the beginning of the EIMP establishment. However, after 7 years of operations it is clear that both the System Manager database and the EEAA database will need upgrading and maintenance.

To meet the future requirements of fast and on-line access to air quality data and assessments we have indicated that that EEAA should start preparing the tools for performing an air quality management planning system. The tools for such assessment and abatement strategy planning procedures are available.

One such system that meets the requirements of modern air quality assessment is the AirQUIS system, which was developed by the Norwegian Institute for Air Research (NILU) (www.NILU.no) to 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. Such system is presently being tested in EEAA.

A cost estimate for immediate investment

Based on the above discussions we have roughly estimated the costs for the immediate investment needed to meet the first priority upgrading of the PM_{10} monitoring system for EEAA.

Cost estimate actions for PM10		
Item	no	1000 LE
PM 10 monitor betagauge	5	800
Consumables&spare parts		60
Preparation and training		80
Total		940

**)instrument price includes taxes in Egypt*

A rough estimate thus indicates that the cost for upgrading the air quality monitoring system for EEAA will be 940,000 LE. The total annual operational costs have been previously estimated at about 2 million LE.

Appendix B6: Memo

Environmental Information
and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **10 October 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed (HAA), Ashraf Saleh Ibrahim(ASI)
From: **Bjarne Sivertsen (BS) and Rolf Dreiem (RD)**

Photo diode PM_{10} monitors

As part of the efforts to repair some of the Wedding type PM_{10} motors, which have been broken down due to a "time-out" of the photo diodes, the following discussions are quoted from EIMP-NILU-TEI Instruments correspondence.

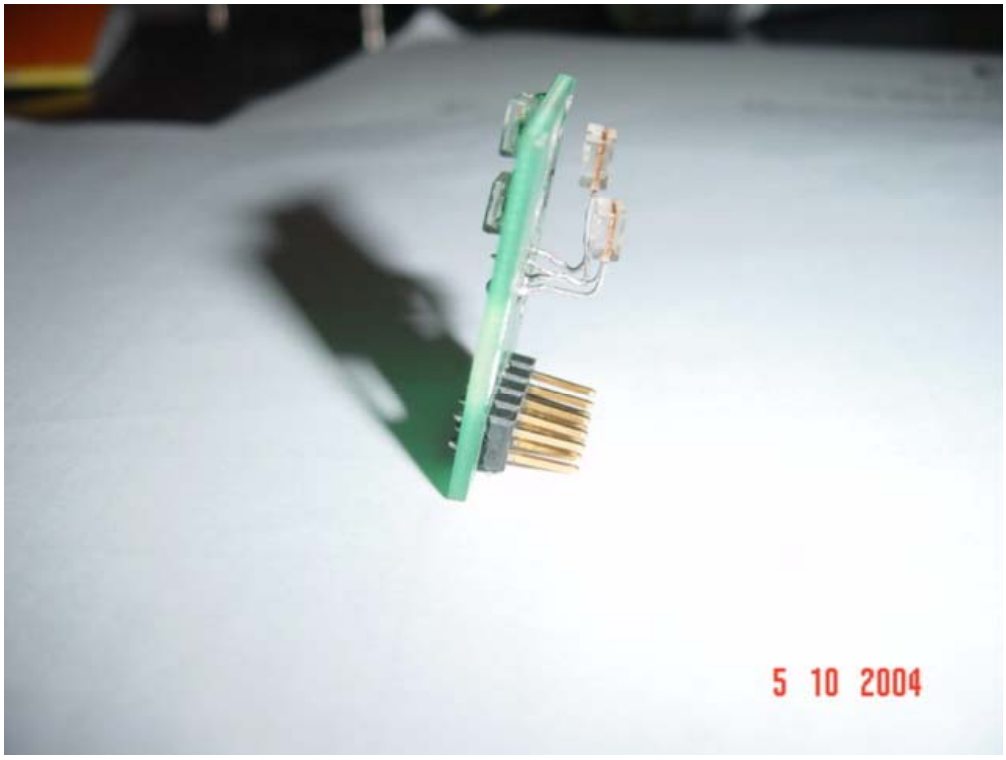
From NILU:
The 24 automatic stations running under the EIMP project has been in operation since 1997 and I think many of the instruments will soon be ready for replacement. We have so far recommended TEI instruments and would like to continue doing so but we need to be sure that you can deliver spare parts. The ongoing projects are supposed to run for many years to come

In the case of the TEI model 650 PM10 monitors we received the last monitors before the model line was shut down. We therefore would like to ask you if it would be possible to exchange one of the old 650s or Eberline to a new Eberline. One instrument was transferred to CTS in Cairo just a few months after we received it, and it has been at CTS since (at least one year!).

It has not been possible for us to have him repair it and return it to EEAA/CEHM. Please support us to get this instrument or a new one back!!

From TEI instruments:
We are sending you a manual for Eberline (in German). I need to check concerning this FH 62 that should be with CTS. I have no information on that system. As far as support for our current range goes, we have committed ourselves for several projects to 10 years support and spare parts after obsolescence of the products so that should be no issue. Problem with the Wedding was that it was not our product. Thermo bought that organisation and soon after the product was discontinued. That is all I know about this. I will check if any company still makes parts for that. Usually there are small companies taking over that sort of activities but in this case I don't know if it happened as well.

From Rolf:
I have taken pictures of the Photo diods in the Wedding PM_{10} monitor (see below).
Will it be possible for NILU to identify the diodes, and try to get similar brands?



The answer from NILU was negative, as there is no identification on the diodes.
They are probably produces especially for that instrument only.

The possibility of getting this part to repair that Wedding type PM_{10} monitors is thus very small.

Appendix B7: Memo

Environmental Information and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **20 September 2004**
To: AAA, HAA, ASI
Copy: Tarek
From: **Bjarne Sivertsen (BS)**

Low SO_2 concentrations in sequential samplers

The problem of measuring too low SO_2 values from the use of impregnated filters in the NILU sequential sampler have been discussed at several occasions, and some of the reasons are summarised below.

Sulphate aerosol formed in the atmosphere?

If SO_2, an acid gas, reacts in the atmosphere with alkaline dust e.g. CaO or Ca CO3, it will end up as CaSO4. Depending on the size of such particles, it may end up in the aerosol filter in the filter holder.

If nearly all SO_2 in the air react like this, and enter the pre-filter, the sum of SO4 there and SO_2 on the impregnated filter should be equivalent with the original SO_2 in the air.

Reactions in intake tube

There may be some reasons why the particles don't reach the impregnated filter:

1) They may be bigger (heavier) than the cut off size for the air intake of the sampler. The cut off size of the intake funnel will depend on the wind velocity.
2) They may settle in the intake tube. (Try to analyse the washing-solution from a cleaning of a used intake tube for SO4)

If the emitted SO_2 still enter the intake system as SO_2, it may react with alkaline dust already deposited in the intake tube.

SO_2 may also react on alkaline particles already sampled by the pre-filter, but again it will be found as SO4 when the pre-filter is analysed.

Inefficient absorption on the filter

The last possibility to measure too low SO_2 concentrations with the impregnated filter method is an inefficient absorption of SO_2 on that filter. The absorption of SO_2 needs some water to be efficient, and a completely dry filter may be inefficient. This may happen if the humidity of the air is "lost" when the air is heated from its outside temperature. This is why the impregnated filter method originally is used with the filter holder directly in the intake funnel in the ambient air. The addition of glycerol to the impregnation solution is meant to minimise this problem.

The efficiency of the impregnated filter could be controlled by placing a 0.3% H2O2-absorption solution behind the filter holder and analyse the exposed solution for SO4 by ion chromatography.

Appendix B8: Memo

Environmental Information and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **24 October 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed (HAA), Ashraf Saleh Ibrahim(ASI), Tarek El Araby and Elsayed Shallaby
From: **Bjarne Sivertsen (BS)**

Field tests for identifying SO_2 concentration levels

The problem

The problem of measuring too low SO_2 values from the use of impregnated filters in the sequential samplers have been discussed at several occasions. To verify some of the reasons presented in the Memo dated 20 September 2004, we have indicated some field tests below.
An investigation using different kinds of monitors and samplers at the same site will be undertaken. We have brought one EMEP filter sampler from NILU. This sampler holder is placed outside the shelter so that the sampling on impregnated filters are undertaken without pulling the air through tubes and sampling equipment which may be impacted by dust deposition.

The sites

The sites selected for these studies are:

1. Tabbin south; sequential sampler, passive sampler and EMEP sampler
2. Nasr City: sequential sampler, passive sampler and EMEP sampler
3. ElShouhada: SO_2 monitor, sequential sampler, passive sampler and EMEP sampler

The experiment should be undertaken over one week at each site. It may be possible to select several weeks more sites if required.

Procedure

1. Install the EMEP sampler in the shelter start it to collect 24-h average sample.
2. Check that the sequential sampler is operating perfectly.
3. Where a SO_2 monitor is available, calibrate and check the instrument

4. Prepare the passive sampler
5. Start sampling at the same time with all equipment
6. Collect data for one week, analyse in laboratory.

If possible try to collect several 24-hour average samples with the EMEP sampler.

Appendix B9: Memo

Environmental Information and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **24 October 2004**
To: Bjarne Sivertsen
Copy: Ahmed Abou Elseoud (AAE), Haytham Ahmed (HAA), Ashraf Saleh Ibrahim(ASI) and Elsayed Shallaby
From: **Tarek El Araby**

Modification of PM_{10} HiVol. and MinVol. Samplers Operation Schedules and Criteria to select filters for Lead Analysis

Sampling time schedules

The operation of HiVol and MinVol Samplers of PM_{10} follow the same schedule, which was implemented by CAIP. This schedule make all instruments at all stations to be operated in sampling PM_{10} on the same day every six calendar days. This mean that we don't have a picture on the pollution levels on the rest of the week also we could not catch any episode or peak level in the intervening days.

So I propose to operate the PM_{10} HiVol. and MinVol. samplers belonging to different stations in different week days at Greater Cairo Region. This will help in having daily PM_{10} sampling data coming out from different stations in Greater Cairo Region. In episodes season we can change the sampling frequency to be three or four days.

Selection of filters for lead analyses

Lead Analysis must be performed on the filters having PM_{10} concentrations higher than certain agreed value (ex. Twice the Air Quality Limit).

Appendix C

QA/QC and Reference laboratory

Appendix C1: Audit seminar

Environmental Information
and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Audit Seminar

Date: **29 September 2004**
Present: NIS: Dr. Samir Lawandi, Adel Shehata, Mohamed Nour, Ms. Alyaa, EEAA/EIMP: Haytham, Ashraf, Wahil, CEHM: Dr Moussa, IGSR: Dr Elayed Shallaby, Dr. Shawkat
Referent: **Bjarne Sivertsen**

Audit seminar at NIS

Introduction

Dr Adel B Shehata (Quality Manager at NIS) presented the conclusions from the Audits performed during January to June 2004. Some non-compliance reports have been given to the monitoring institutions, and corrective actions have been received and much of the corrections have been undertaken. Also general comments have been presented to many of the audit reports from the monitoring institutions.

Some site comments

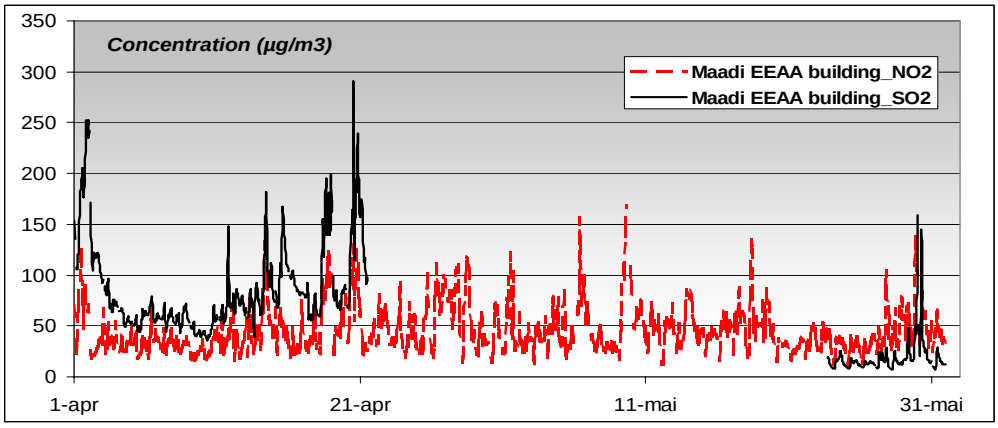
The NOx monitor at **Tabbin** hade been one of the issues discussed between NIS and CEHM. After calibration of the instrument at CEHM, the instrument was sent to NIS for verification and approval. NIS found that the calibration was not in accordance with their findings, and recalibrated the instrument. (This changed the zero line from 12 to 53). The monitor was then returned to Tabbin.

At audit of the Tabbin station in April it was given a “Non compliance” remark. According to CEHM this was because of the recalibration at NIS!

After a long discussion it was concluded that any changes in calibrations (if any) undertaken by NIS after calibration at CEHM had to be very clearly communicated. This problem has mainly been one of communication failure.

Also it was stated that calibration certificates always have to follow the instruments wherever it goes. **Rolf Dreiem (RD)** was also requested to follow an instrument calibration routine undertaken both at NIS and CEHM. Perhaps we could use the same NOx monitor from Tabbin for this exercise?

An Audit was performed at Maadi on 21 April 2004. On the same day the data from Maadi went wrong and it was later deleted from the records, as seen in the figure below.



The main reason was the high zero level as can also be seen before 21 May. The monitor was returned to the site in the last week of May, and the zero level had now been adjusted.

At Gomhoreys there was no field calibration undertaken due to the lack of gas regulators. At this site and at one more site it was stated that field calibration gases are not available, and that a complete set of gas regulators should be ordered by EEAA. Moving regulators from one site to another may cause losses of gar, which in the long run may be more expensive than buying the regulators.

This was also stated in a memo of 22 March 2004. (See Mission 04 report, Appendix B5), where it was said:
In order to have atmospheric pressure in the sample line to the instruments the working gas system **must** contain the following items:

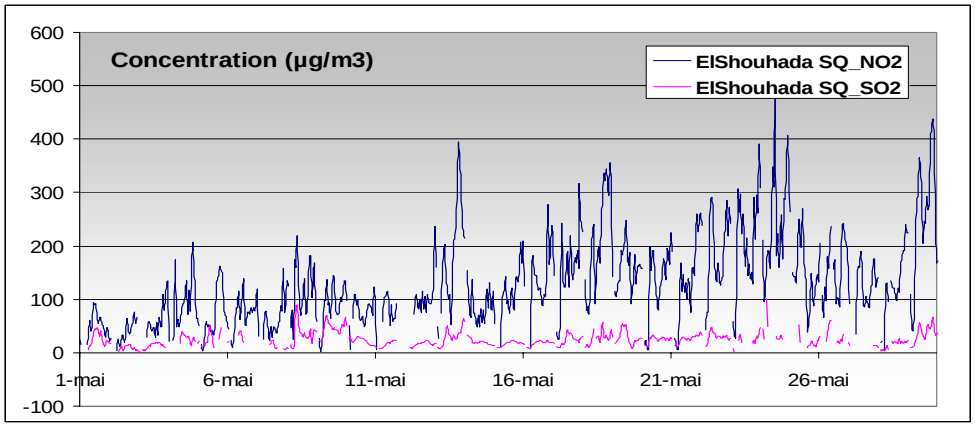
1. Gas Cylinder
2. Regulator
3. Regulator outlet valve
4. Fitting regulator outlet valve (in and out).
5. Plastic T-piece
6. Mini flow meter

The items from 3 to 6 listed above are presently totally missing in the system.
Items 3 and 4 will have to be purchased from the regulator supplier.
Items 5 and 6 may be obtained from the local market.

Conclusion and cost estimate
To enable a proper calibration routine, assuring that gas is not being lost in the system, it is urgently important to acquire all missing parts listed above. This is crucial for the new calibration system to be successfully implemented.
The missing parts have been cost estimated to about 60 000 EL.

At **Quolaly** the calibration certificate had not been authorised. This matter has been taken care of now.

At **ElShouhada** there was malfunctions in a solenoid valve during the Audit on 24 May 2004. The responsible station operator had not been available during the Audit, due to other important meetings.



The NOx monitor was found to be more than 28 % out of the specification of the travelling cylinder gas concentration. No action had been taken even if the site visit report as of 18 May also indicated that the NOx concentrations were out of range. These procedures have to be followed adequately in the future!

The data plot shown in the figure above cannot identify any major change on 24 May. However ha range and values of NO_2 seem to be very large. The need for a good quality recalibration may have been adequate. The SO_2 concentrations on the other hand were low at ElShouhada in May.

At **Gheat ElEnab** the high volume sampler could not be checked, as there were no blank filters at the site. IGSR never had any storage of blank filters. This should have been changed, and CEHM will be requested to provide IGSR with some extra blank high volume filters at any time.

Third party audits
Some sampler sheets, such as at Damietta, had not been found during the Audits. This has been identified by IGSR later. Samples at ElMax station were not collected in time.

Yhere were also several minor comments and discussions concerning the follow-up of SOPs and the training and CVs of the personnel.

Annual calibration
Dr Samir requested the monitors that are supposed to be annually calibrated at NIS. All ozone monitors seem to arrive at NIS. Other monitors, however, had not turned up. NIS is supposed to calibrate a total of 19 monitors. Only of few of these have been turned in so far.

The samplers, however, seem to be on schedule.

A complete list of monitors for calibration was requested (part of the NIS contract). This list will be provided for the Monitoring Institutions and the missing monitors

will be identified. It was assumed that a number of these might be out of operation due to lack of spare parts.

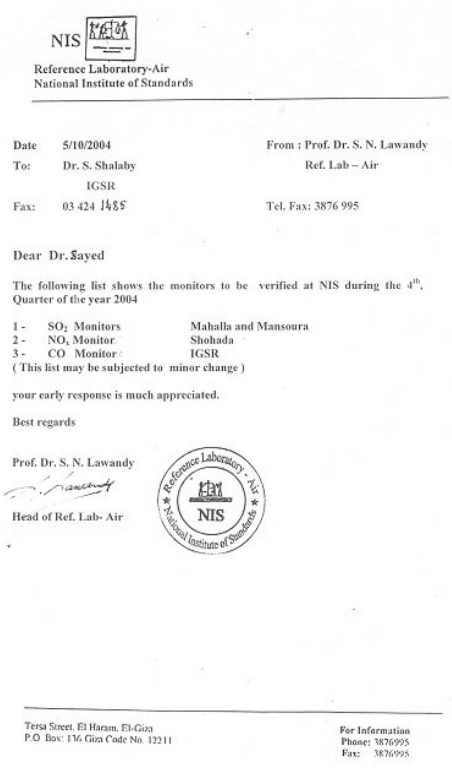
Appendix C2: Fax

Environmental Information and Monitoring Programme Phasing out Phase

Fax

Monitors for verification of multipoint calibrations

The following Faxes were sent to identify the monitors, which were supposed to be multipoint calibrated on an annual basis and verified by NIS.



NIS
Reference Laboratory-Air
National Institute of Standards

Date 5/10/2004 From : Prof. Dr. S. N. Lawandy
To: Dr. S. Shalaby Ref. Lab – Air
IGSR
Fax: 03 424 1485 Tel. Fax: 3876 995

Dear Dr. Sayed

The following list shows the monitors to be verified at NIS during the 4th, Quarter of the year 2004

1 - SO_2 Monitors Mahalla and Mansoura
2 - NO_x Monitor Shohada
3 - CO Monitor IGSR
(This list may be subjected to minor change)

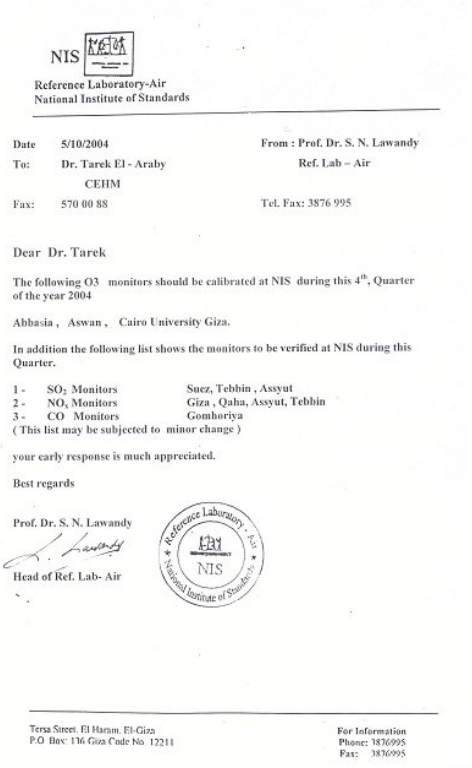
your early response is much appreciated.

Best regards

Prof. Dr. S. N. Lawandy
Head of Ref. Lab- Air

Reference Laboratory - Air
NIS
National Institute of Standards

Tersa Street. El Haram. El-Giza
P.O Box: 136 Giza Code No. 12211
For Information
Phone: 3876995
Fax: 3876995



NIS
Reference Laboratory-Air
National Institute of Standards

Date 5/10/2004 From : Prof. Dr. S. N. Lawandy
To: Dr. Tarek El - Araby Ref. Lab – Air
CEHM
Fax: 570 00 88 Tel. Fax: 3876 995

Dear Dr. Tarek

The following O3 monitors should be calibrated at NIS during this 4th, Quarter of the year 2004

Abbasia , Aswan , Cairo University Giza.

In addition the following list shows the monitors to be verified at NIS during this Quarter.

1 - SO_2 Monitors Suez, Tebbin , Assyut
2 - NO_x Monitors Giza , Qaha, Assyut, Tebbin
3 - CO Monitors Gomhoriya
(This list may be subjected to minor change)

your early response is much appreciated.

Best regards

Prof. Dr. S. N. Lawandy
Head of Ref. Lab- Air

Reference Laboratory - Air
NIS
National Institute of Standards

Tersa Street. El Haram. El-Giza
P.O Box: 136 Giza Code No. 12211
For Information
Phone: 3876995
Fax: 3876995

Appendix C3: Memo

Environmental Information
and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **4 October 2004**
To: **A**hmed Abou Elseoud (AAE),
Copy: HAA, ASI, Tarek
From: **Bjarne Sivertsen (BS)**

Monitor calibrations at CEHM and at NIS.

Introduction

Calibrations and verifications of monitor calibrations are to take place at NIS after major repairs at CEHM and on a routine basis for annual check and calibration. A list of monitors to be calibrated annually was requested from NIS after the Audit Seminar on 29 September 2004.

From calibrations undertaken during March 2004 it has been verified a large difference between calibrations performed at CEHM and at NIS. This will have to be further studied and the reasons identified and corrected. The documentation is presented below.

Calibration verification

SO2 monitors

The table below shows the differences in calibrations of 3 SO_2 monitors at CEHM and NIS performed in March 2004.

Date	Station	S/N	Factors		Difference		Remark
March 04			**CEHM**	**NIS**	**(ppb)**	**(%)**	
3 and 23	Tabbin	57681-316	1000	1109	87.2	10.9	
11 and 15	Suez	61642-332	1000	?	?	?	Factors not stated in certificate
14 and 15	Assyut	61643-332	1000	1067	53.6	6.7	NIS factor entered after, not stated in certificate

The largest deviation between CEHM and NIS was 10.9 %. The reason for this is still not known. There could be errors in the dilution systems at any of the institutes. This will be looked into.

NIS is using a Teflon filter between the gas out of the 146 calibrator and the monitor. This is not necessary even if it may not influence on the results.

NOx monitors

Three NOx monitors were also calibrated in March 2004. The results are shown below.

Date	Station	S/N	Factors		Difference		Remark
March 04			CEHM	NIS	(ppb)	(%)	
3 and 9	Kaha	57751-314	1000	1073	58.4	7.3	
14 and 16	Assyut	57636-314	993	1107	91.8	11.5	
17 and 22	Tabbin	57866-315	1000	1174	139.2	17.4	

The largest deviation between CEHM and NIS was 17.4 %. The reason for this is still not known. However, it is worth remarking that the difference is increasing for every calibration undertaken.

CO monitor

One CO monitor was calibrated in March 2004.

Date	Station	S/N	Factors		Difference		Remark
March 04			CEHM	NIS	(ppm)	(%)	
10 and 13	Gom-horeya	58213-317	1055	1096	2.72	3.9	

The difference between CEHM and NIS was 3.9 %. Again we will have to check the reason and find out if this may be corrected.

Calibration routines and time schedules

It was mentioned at the Audit Seminar at NIS on 29 September 2004 that a total of 19 monitors were to be calibrated during this year. Only 7 of them had been arriving at NIS so far.

Very strangely all of these were sent to NIS during the last visit of the expatriate experts in March 2004. From that time till the next Mission in September-October 2004 no calibration of monitors have been performed at NIS. This may be a coincidence, but we are looking into the matter to obtain the list of instruments to be calibrated based on an annual schedule issued by NIS.

Appendix C4: Audit reports

Audit reports from sites visited during Mission 05

The complete set of Audit reports from the Audit performed by the NLU expert is presented in a separate report. In this appendix we have presented reports from two sites as an example.

Sheet Number:

Station audit

1. General information

Station: **El Shouhada**..... St. Id: AQ24 ..... Date: 10 Oct. 2004 .....
Auditor: Rolf Dreiem..... Sign: RD .....
Audit institution: NILU .....
Responsible technician: Mohamed Rassad..... Present y/n: N .....
Institution: IGSR.....
Local maintenance personnel: Hossam ..... Present y/n: Y .....
Date of last audit: 24. May 2004 ...

2. Technical system audit

2.1. Facilities

Controlled access to station y/n:Y..... Door always locked y/n: Y .....
Are there windows y/n: N..... Windows always closed y/n: .....
Air condition y/n: Y..... Is it running y/n: Y..... Normal temp. y/n: Y ...
Dust deposits y/n: Y ..... Dust removal frequency: Monthly.....
From where is the dust coming: From the door.....

2.2. Equipment

Dust deposits inside instruments y/n: N..... Dust removal frequency: Monthly .
Dust deposits inside tubes/manifold y/n: Y.. Dust removal frequency: 1 year? ...
Any instruments not working (which): No.....
What is the plan for malfunctioning instruments: .....
.....

2.3. Operations

Are necessary SOPs available y/n:Y..... Are SOPs of latest version y/n: Y.....
Are necessary forms available y/n: Y..... Are forms of latest version y/n: Y .....
Are the instrument Instruction manuals available y/n: Y .....
Is the technician familiar with the QC documentation y/n: Y ....

16.12.2004 El Shouhada Station Audit.doc Issue No. 003 99.12.01

Sheet Number:

2.4. Record keeping

Is the Station manual available y/n: Y.....

Is the Station visit log maintained and signed at every visit y/n: Y.....

Are the pages in the visit log numbered y/n: N .....

Are Site visit log forms, maintenance forms and other forms older then 3 months brought to the laboratory for archiving in the History log y/n: N .....

2.5. Maintenance

Date of last maintenance visit: 31. Mars 2004

Actual maintenance frequency: ?????? ... Scheduled frequency: Weekly .....

Is maintenance performed according to the SOP y/n: N.....

Air intake filter change frequency: No .....

Only filter change on Air Metrics. No action on NOx and SO2 monitors.

16.12.2004

Sheet Number:

2.6. Calibration procedures

There is one sheet for each instrument.

Instrument: TEI 43C SO2 .....

Type of performance check unit: Zero calibrator and span gas cylinder. .....

Are the performance check acceptance criteria available y/n: N .....

Are the field calibration acceptance criteria available y/n: N .....

	Last performed	Actual frequency	Scheduled frequency
Manual performance check	21. Aug. 04	??????	Weekly
Automatic Z/S check	-------	-------	---------
Field calibration	16. Mars. 04	??????	3 months

16.12.2004

Sheet Number:

Performance evaluation audit - Gas monitors

There is one sheet for each instrument.

Instrument: TEI 43 C SO2..... Serial number: 58165-316 .....

Zero level check monitors.
Values recorded from two zero checks on the maintenance sheet:

Date	31. Aug. 04			
Parameter	SO2			
Response	0.1 ppb			
Acceptance criteria	-3-+5 ppb			
AC≤ Resp≤AC y/n	Y			

Remember to add measurement units! **No zero found after 31. Aug. 04.**

Span check monitors.
Values recorded from two span checks on the maintenance sheet: **No span check found after 16. Mars 2004. Span gas cylinder at station. Last time used 16. Mars 2004.**

Parameter	SO2			
Response				
Working standard				
Difference				
Dev = 100 * Diff / Wrk. std.				
Acceptance criteria				
|Dev| ≤ AC y/n				

Remember to add measurement units!

Comparison with travelling standard:

Parameter		
Response		
Travelling standard		
Difference		
Dev = 100 * Diff / Trv. std.		
Acceptance criteria		
|Dev| ≤ AC y/n		

Remember to add measurement units!

AC = Acceptance criteria

16.12.2004 El Shouhada Station Audit.doc Issue No. 001 99.12.01

Non-compliance report no 1 .....

Place/area: El Shouhada..... Station id: AQ 24.....

Reference document(s): Station audit 2.1, 2.2 and 2.4.....

Name of auditor: Rolf Dreiem .....

Date: 10. Oct. 2004 .....

Non-compliance: **Dust deposit inside station.** **Dust deposit inside air intake.** **Pages in visit log not numbered.** **Forms older than 3 months are in the visit log.**		
Signatures:	**Auditor: Rolf Dreiem**	**For the institution: Hossam**

Corrective action(s): **Cleaning.** **New responsible for the station from this week is Hossam.**
Date when corrective action will be completed: 1 week.

Signature of manager responsible for place/area where the non-compliance is identified.

Corrective action implemented:	**El Sayed Shalaby** **Name**	**Signature**	**12. Oct. 04** **Date**

Corrective action confirmed by auditor:	**Signature**	**Date**

16.12.2004 Non-compliance.doc Issue No 002, 99.03.15

Non-compliance report no 2 .....

Place/area: El Shouhada..... Station id: AQ 24.....

Reference document(s): Station audit 2.5 and 2.6.....

Name of auditor: Rolf Dreiem .....

Date: 10. Oct. 2004 .....

Non-compliance:		
2.5 Last visit 6 weeks ago, not weekly. Maintenance is not done on monitors, only on Air Metrics samplers. **2.6 Performance check is not available. Field calibration is not available.** **Shalaby claims the operator was at station every week. He changes filter on Air Metrics sampler.**		
Signatures:	**Auditor: Rolf Dreiem**	**For the institution: Hossam**

Corrective action(s):
Hossam becomes the responsible for all Alexandria stations instead of Mohamed Rashad.
Date when corrective action will be completed: 1 week.

Signature of manager responsible for place/area where the non-compliance is identified.

Corrective action implemented:	**Name**	**Signature**	**Date**

Corrective action confirmed by auditor:	**Signature**	**Date**

16.12.2004 Non-compliance.doc Issue No 002, 99.03.15

Non-compliance report no 3 .....

Place/area: El Shouhada..... Station id: AQ 24.....

Reference document(s): Performance evaluation audit. Gas monitors .....

Name of auditor: Rolf Dreiem .....

Date: 10. Oct. 2004 .....

Non-compliance:		
No zero check found after 31. Aug. 2004. **No span check found after 16. Mars. 2004.**		
Signatures:	**Auditor: Rolf Dreiem**	**For the institution: Hossam**

Corrective action(s):
Zero/span check starts next week.
Date when corrective action will be completed: 1 week.

Signature of manager responsible for place/area where the non-compliance is identified.

Corrective action implemented:	**Name**	**Signature**	**Date**

Corrective action confirmed by auditor:	**Signature**	**Date**

16.12.2004 Non-compliance.doc Issue No 002, 99.03.15

Sheet Number:

Station audit

1. General information

Station: **Tebbin** ..... St. Id: AQ 06 ..... Date: 18. Oct. 2004 .....
Auditor: Rolf Dreiem..... Sign: RD .....
Audit institution: NILU .....
Responsible technician: Maher..... Present y/n: Y .....
Institution: CEHM.....
Local maintenance personnel: No ..... Present y/n: .....
Date of last audit: 21. April 2004 ..

2. Technical system audit

2.1. Facilities

Controlled access to station y/n: Y..... Door always locked y/n: Y .....
Are there windows y/n: Y..... Windows always closed y/n: Y .....
Air condition y/n: Y..... Is it running y/n: Y..... Normal temp. y/n: Y ...
Dust deposits y/n: N ..... Dust removal frequency: 2 Weeks.....
From where is the dust comming: Windows .....

2.2. Equipment

Dust deposits inside instruments y/n: N ..... Dust removal frequency: Monthly .
Dust deposits inside tubes/manifold y/n: N.. Dust removal frequency: 2 wweks .
Any instruments not working (which): TSP.....
What is the plan for malfunctioning instruments: Waiting for new brushes. .....
.....

2.3. Operations

Are necessary SOPs available y/n: Y..... Are SOPs of latest version y/n: Y.....
Are necessary forms available y/n: Y..... Are forms of latest version y/n: Y .....
Are the instrument Instruction manuals available y/n: Y .....
Is the technician familiar with the QC documentation y/n: Y ....

16.12.2004 Tebbin Station Audit.doc Issue No. 003 99.12.01

Sheet Number:

2.4. Record keeping

Is the Station manual available y/n: Y.....

Is the Station visit log maintained and signed at every visit y/n: Y.....

Are the pages in the visit log numbered y/n: Y .....

Are Site visit log forms, maintenance forms and other forms older then 3 months brought to the laboratory for archiving in the History log y/n: Y .....

2.5. Maintenance

Date of last maintenance visit: 13. Oct. 2004

Actual maintenance frequency: Weekly.. Scheduled frequency: Weekly .....

Is maintenance performed according to the SOP y/n: Y.....

Air intake filter change frequency: 2 weeks .....

16.12.2004

Sheet Number:

2.6. Calibration procedures

There is one sheet for each instrument.

Instrument: TEI 42C NOx .....

Type of performance check unit: Zero calibrator and gas cylinder .....

Are the performance check acceptance criteria available y/n: Y .....

Are the field calibration acceptance criteria available y/n:Y .....

	Last performed	Actual frequency	Scheduled frequency
Manual performance check	6. Oct. 04	*Monthly	Weekly
Automatic Z/S check	Zero dayly.		
Field calibration	7. Oct. 04	6 months	3 months

*Manual span check every month to save span gases.

16.12.2004

Sheet Number:

Performance evaluation audit - Gas monitors

There is one sheet for each instrument.

Instrument: TEI 42C NOx ..... Serial number: 57866-315 .....

Zero level check monitors.
Values recorded from two zero cheks on the maintenance sheet:

Date	18. Oct. 04		16. Sept. 04	
Parameter	NO	NOx	NO	NOx
Response	0.6 ppb	1.0 ppb	-0.2 ppb	-0.3 ppb
Acceptance criteria	-3-+5 ppb	-3-+5 ppb	-3-+5 ppb	-3-+5 ppb
AC≤ Resp≤AC y/n	Y	Y	Y	Y

Remember to add measurment units!

Span check monitors.
Values recorded from two span cheks on the maintenance sheet:

Parameter	NO	NOx	NO	NOx
Response	626 ppb	1268 ppb	625 ppb	1270 ppb
Working standard	625 ppb	1279 ppb	625 ppb	1279 ppb
Difference	1 ppb	-11 ppb	0 ppb	-9 ppb
Dev = 100 * Diff / Wrk. std.	0.16 %	0.86 %	0 %	0.7 %
Acceptance criteria	15 %	15 %	15 %	15 %
|Dev| ≤ AC y/n	Y	Y	Y	Y

Remember to add measurment units!

Comparison with travelling standard: **No travelling standard used.**

Parameter		
Response		
Travelling standard		
Difference		
Dev = 100 * Diff / Trv. std.		
Acceptance criteria		
|Dev| ≤ AC y/n		

Remember to add measurment units!

AC = Acceptance criteria

16.12.2004 Tebbia Station Audit.doc Issue No. 001 99.12.01

Non-compliance report no 1 .....

Place/area: Tebbin ..... Station id: AQ 06.....

Reference document(s): Station audit 2.2.....

Name of auditor: Rolf Dreiem .....

Date: 18. Oct. 2004 .....

Non-compliance:		
TSP not working.		
Signatures:	**Auditor: Rolf Dreiem**	**For the institution: Maher**

Corrective action(s):
Waiting for spare parts (ordered).
Date when corrective action will be completed: When new spare parts arrive.

Signature of manager responsible for place/area where the non-compliance is identified.

Corrective action implemented:	**Name**	**Signature**	**Date**

Corrective action confirmed by auditor:	**Signature**	**Date**

16.12.2004 Non-compliance.doc Issue No 002, 99.03.15

Non-compliance report no 2 .....

Place/area: Tebbin ..... Station id: AQ 06.....

Reference document(s): Station audit 2.5 and 2.6.....

Name of auditor: Rolf Dreiem .....

Date: 18. Oct. 2004 .....

Non-compliance:		
Weekly maintenance form not filled inn every week. **Manual performance check every month.** **No travelling standard used.**		
Signatures:	**Auditor: Rolf Dreiem**	**For the institution: Maher**

Corrective action(s):
Start making maintenance form from next visit. **Start making Zero/Span by cylinder every week.** **Start using travelling standard every 3 months.**
Date when corrective action will be completed: Next week.

Signature of manager responsible for place/area where the non-compliance is identified.

Corrective action implemented:	**Name**	**Signature**	**Date**

Corrective action confirmed by auditor:	**Signature**	**Date**

16.12.2004 Non-compliance.doc Issue No 002, 99.03.15

Appendix C5: Memo

Environmental Information and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **15 September 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed (HAA), Bjarne Sivertsen
From: **Ulla Lund (UOL)**

Traceability at Reference Laboratory – Air

Introduction

The activities to ensure trace ability for calibrations at Reference Laboratory – Air are at present organised in the following way:

1. The Reference Laboratory performs calibrations, audits etc.,
2. EEAA purchases the reference gases and the calibration services from Switzerland necessary to establish trace ability in the calibration and other activities.

I have commented on this arrangement as less than optimal in several end-of-mission reports, and negative effects were again brought to my attention during audit at Reference Laboratory – Air today.
The present memo is an attempt to summarise the background and to give advise concerning the arrangements.

Responsibilities

From a quality assurance point of view, a laboratory must be fully responsible for all parts of its operations. Only in this way can an auditor blame the laboratory for any lack of trace ability that may occur if for example the certificates of reference gases expire.

In the present organisation both the Reference Laboratory and EEAA are involved in purchase of gases and calibration services from abroad. When gases are expired, the Reference Laboratory blames EEAA and no doubt EEAA may say that the Reference Laboratory did not give due notice of their need. Both may be right or wrong but that is beside the point. The point is that the system does not ensure that there is only one place to lay the blame if certificates are expired.

This split responsibility may be avoided if the Reference Laboratory is given full responsibility for purchasing reference gases as well as calibration services for

ozone calibrator and multipoint calibrator. The costs may be included in the contract for the Reference Laboratory under a budget that can only be used when EEAA receives copies of the invoices from the companies supplying gases and calibration services.
A positive side effect from such an arrangement will be that the need for foreign currency will no longer be EEAA's responsibility.

Recommendation from Ulla

I recommend that you add the costs for consumption of reference gases and calibration services abroad to the contract for Reference Laboratory – Air. The budget for this must be prepared by Reference Laboratory – Air and submitted to EEAA in due time before the contract is up for renewal. The contract should have a provision that Reflab invoices containing these costs must be accompanied by copies of invoices from the supplier of the gases or calibration services.

Appendix D

Reports

AppendixD1: Daily Reports

Environmental Information and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

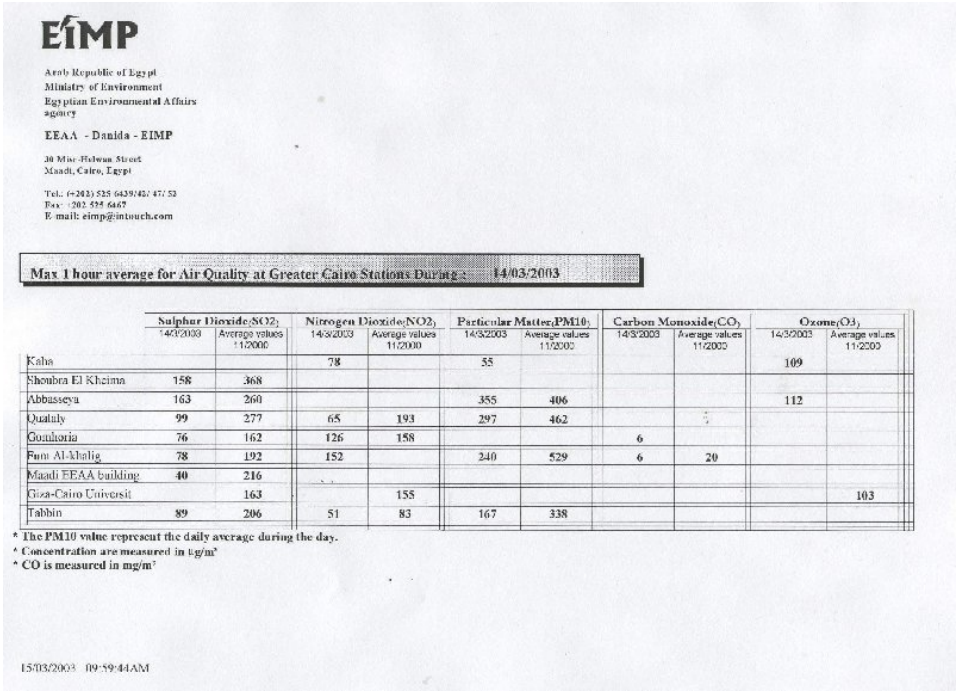
Date: **24 September 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed (HAA), Ashraf Saleh Ibrahim(ASI)
From: **Bjarne Sivertsen (BS)**

Daily reports

Daily reports 2002-2003

Daily reports of the air quality in Cairo have been prepared and made available at the Minister office. The reports were presenting one-hour average daily maximum concentrations of SO_2, NO_2, PM_{10}, CO and Ozone based on data retrieved from tha stations every morning at about 10:00 hrs.

Typical hourly maximum concentrations measured during the last 24 hours (or 8 hours) were prepared and compared to “reference levels” taken as the highest concentrations measured during a selected episode of Cairo.



EIMP

Arab Republic of Egypt
Ministry of Environment
Egyptian Environmental Affairs agency

EEAA - Danida - EIMP

30 Misr-Helwan Street
Maadi, Cairo, Egypt

Tel.: (+202) 525 6420/42/ 47/ 52
Fax: (202 525 6467
E-mail: eimp@intouch.com

Max 1 hour average for Air Quality at Greater Cairo Stations During : 14/03/2003

	Sulphur Dioxide(SO_2)		Nitrogen Dioxide(NO_2)		Particular Matter(PM_{10})		Carbon Monoxide(CO)		Ozone(O_3)	
	14/3/2003	Average values 11/2000	14/3/2003	Average values 11/2000	14/3/2003	Average values 11/2000	14/3/2003	Average values 11/2000	14/3/2003	Average values 11/2000
Kaha			78		55				109	
Shoubra El Khaima	158	368								
Abbasseya	163	260			355	406			112	
Qualuly	99	277	65	193	297	462				
Goulotoria	76	162	126	158			6			
Fum Al-Khalig	78	192	152		240	529	6	20		
Maadi EEAA building	40	216								
Giza-Cairo Universit		163		155						103
Tabbin	89	206	51	83	167	338				

* The PM10 value repreasnt the daily average during the day.
* Concentration are measured in ug/m³
* CO is measured in mg/m³

15/03/2003 09:59:44AM

Daily reports from September 2004-09-20

We suggest that the daily reports to be produced from September 2004 will contain a short statement on the general air quality of Cairo. A table should show the highest concentration during the last day as well as the concentration during the last hour (at data retrieval).

If possible a simple graph should indicate the level compared to the air quality limit values given by the Egyptian Law.
In the future an air pollution forecast for the next 24 hours should be added to the report.

A typical draft example is shown on the next page:

EEAA

EIMP

Daily report on the Cairo Air Quality
Day: 22 September 2004

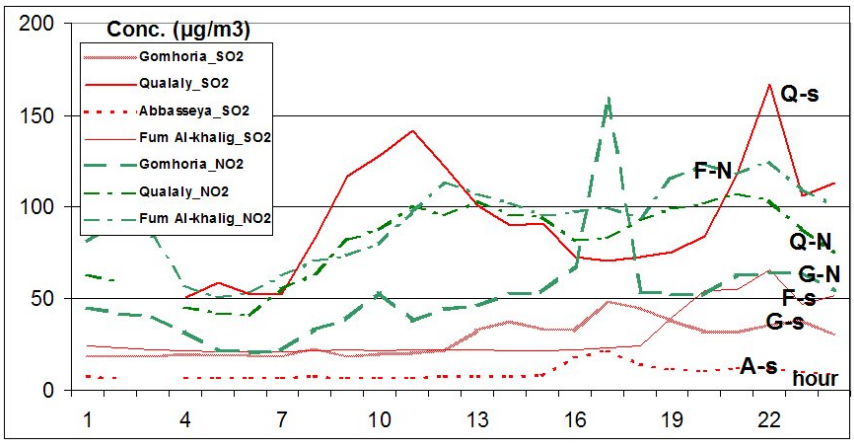
The air quality in Cairo this morning is
good – moderate – **poor** – unhealthy – hazardous *)
The main pollutant is suspended particulate matter
measured at : Quolaly in Central Cairo at __152__ &g/m^3

Day: 3 May 2003	***Max. 1 hour average concentrations last 24 hours (µg/m^3)***				
Site	***SO_2***	***NO_2***	***PM10 (24 h)***	***Ozone***	***CO***
Kaha					
Shoubra El-Kheima					
Abbaseya					
Gomhoria					
Quolaly					
Fum AlKhalig					
Maadi EEAA					
Tabbin					

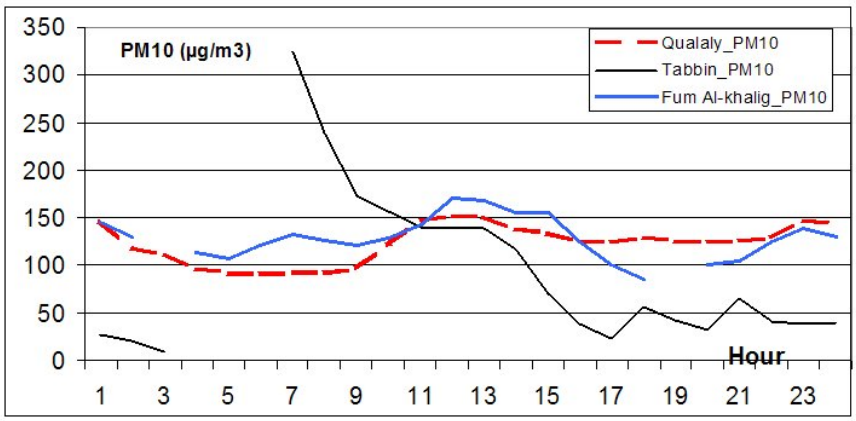
*) *The qualification of air quality could be based on subjective judgement relative to the air quality limit values given by the Law. Another objective way of judging the air quality is by developing an air quality index (AQI) for Cairo (see below).*

Air quality limit values for Egypt		
	(&g/m^3)	**Aver. time**
SO_2	350	1 hour
NO_2	400	1 hour
PM_{10}	70	24 hours
Ozone	200	1 hour
CO	30	1 hour

The graph shows the hourly concentrations of SO_2 and NO_2 in Cairo during the last 24 hours (up till 10:00 hrs)



Other options:
Hourly concentrations of PM_{10} for the last 24 hours could be presented just for information and to indicate the trend in general pollution over the city.



Daily index

To characterise the air quality it may be possible to develop an air quality index (AQI) for Cairo. A selection of four representative stations in the city centre of Cairo could form the basis for this index:
Quolaly, FumAlKhalig, Gemoria and Abbaseya.

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

The hourly sub index, I^h_j, for a given day at the station j is calculated as:

$$I^h_j = Max_{day}(Max_i(C^h_{i,j}/S^h_i)) * 100$$

where
$C^h_{i,j}$ is the hourly average concentration for the specie i at the station j and
S^h_i is the hourly Air Quality Standard for the specie i.

PM_{10} is not included in the calculation of I^h_j as the S for PM_{10} is only given for 24 hour average.
The handling of PM_{10} concentrations in the AQI for Cairo may represent a problem, as the background concentrations are normally very high. I suggest that the new proposed 24 hour average value for PM_{10} at 150 &g/m^3 is being used when producing the daily AQI value.

The daily index, AQI^d_j, is calculated as:

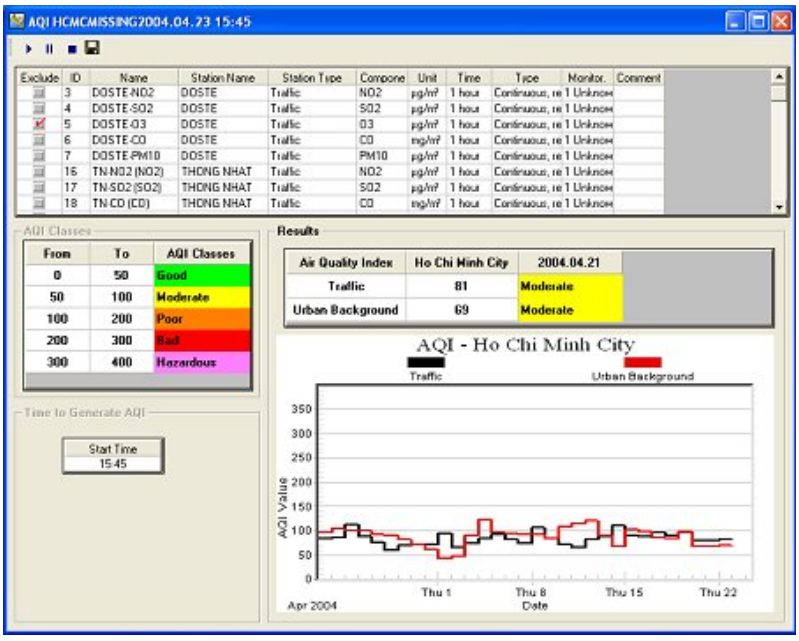
$$AQI^d_j = Max_i(C^d_{i,j}/S^d_i) * 100$$

where $C^d_{i,j}$ is the daily average concentration for the specie i at the station j and
S^d_i is the daily Air Quality Standard for the specie i.

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

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

Typical AQI values generated automatically using AirQUIS in Ho Chi Minh City Vietnam is shown as they appear on the Internet screen. The graph shows daily AQI values for the last month, until “today”.



Appendix D2: Daily report 11-12-October 2004

EEAA

EIMP

Daily report on the Cairo Air Quality
Day: 11-12 October 2004

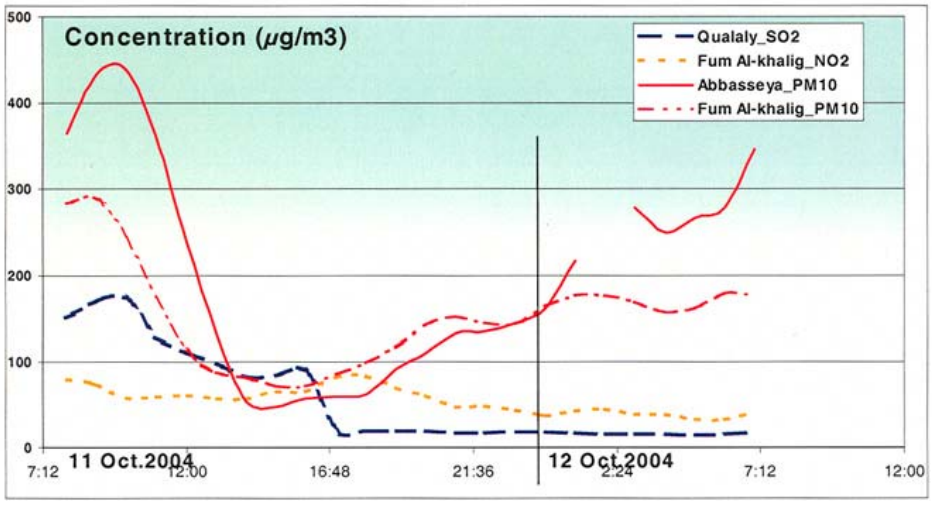
The air quality in Cairo this morning is
Unhealthy*)
The main pollutant was PM_{10} measured at Abbasseya and FumAlKhalig in Central Cairo

Day: 11-12 Oct 2004	Max. 1 hour average concentrations last 24 hours ($\mu g/m^3$)				
Site	**SO_2**	**NO_2**	**PM10 (24 h)**	**Ozone**	**CO**
Abbaseya	104		439		
Gomhoria	52	74			10
Quolaly	174	157			
Fum AlKhalig	113	84	290		9.2
Shoubra					
Maadi EEAA					

The graph shows the hourly concentrations of SO_2 and NO_2 in Cairo during the last 24 hours

Classification		Result	Crit param. & Site
0 to 50	Good		
51 to 100	Moderate		
101 to 200	Poor	193	PM10 FumAlKhalig
201 to 300	Unhealthy	293	PM10 Abbasseya
301 and above	Hazardou		

Air quality limit values for Egypt		
	(&rg/m^3)	Aver. time
SO_2	350	1 hour
NO_2	400	1 hour
PM_{10}	70	24 hrs
O33	200	1 hour
CO	30	1 hour



Appendix D3: AQI for Egypt

Environmental Information and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **28 September 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed (HAA), Usama El-Farmovi, HAA, ASI
From: **Bjarne Sivertsen (BS)**

Characterizing air quality through index values, AQI

Introduction

The requirements of daily reports of the air quality in Cairo have been requested and lead to the need for characterising the air quality through simple index values.

The air we breathe should be clean. From a human health perspective, the main outstanding air pollution problems internationally are particulate matter and tropospheric ozone. Acidification and ozone remain the main threats to ecosystems.

A relatively small number of pollutants such as fine particulates (PM_{10}), SO_2, NO_2, CO, O3 and NMVOC are the main causes of the health impact in urban areas. A significant development during the past few years has been a shift to a multi-pollutant, multi-effect air pollution abatement strategy. From this point of view a number of Environmental Agencies have also developed simplified indexes to characterise the pollution levels especially in urban areas. The objectives have been to give the public a simple number or understandable way of qualifying the atmospheric pollution.

Also in Cairo this has been attempted through a classification scheme linked to the development of air quality forecasts (El-Shahawi, 2001). Dr M Nasrallah established in 2002 a first classification for the Cairo air quality characterisation based on measurements of PM_{10}.

Also as part of the daily reporting of the EIMP programme a classification scheme was presented based on internationally recognised methods for characterising air pollution through AQI values. (Sivertsen, 2004 a)

This memo summarised the two methods and try to merge the characterising of the air of Cairo into one system.

What is the AQI?

The AQI is an index for reporting daily air quality. It tells you how clean or polluted the air is, and what associated health concerns you should be aware of. The AQI focuses on health effects that can happen within a few hours or days after breathing polluted air. Among the many authorities using this system the USEPA developed an AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particulate matter, carbon monoxide, sulphur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect against harmful health effects.

How does the AQI work?

You can think of the AQI as a yardstick that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health danger. For example, an AQI value of 50 represents good air quality and little potential to affect public health, while an AQI value over 300 represents hazardous air quality.

An AQI value of 100 generally corresponds to the national air quality limit value or standard for the pollutant, which is the level normally set to protect public health. So, AQI values below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is considered to be unhealthy—at first for certain sensitive groups of people, then for everyone as AQI values get higher.

Understanding the AQI

The purpose of the AQI is to help you understand what local air quality means to your health. To make the AQI as easy to understand as possible, the USEPA has divided the AQI scale into six categories, shown below:

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	*...air quality conditions are:*	*...as symbolized by this color:*
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

Each category corresponds to a different level of health concern. For example, when the AQI for a pollutant is between 51 and 100, the health concern is “Moderate.” Here are the six levels of health concern and what they mean:

"Good" The AQI value for your community is between 0 and 50. Air quality is considered satisfactory and air pollution poses little or no risk.
"Moderate" The AQI for your community is between 51 and 100. Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of individuals. For example, people who are unusually sensitive to ozone may experience respiratory symptoms.
"Unhealthy for Sensitive Groups" Certain groups of people are particularly sensitive to the harmful effects of certain air pollutants. This means they are likely to be affected at lower levels than the general public. For example, children and adults who are active outdoors and people with respiratory disease are at greater risk from exposure to ozone, while people with heart disease are at greater risk from carbon monoxide. Some people may be sensitive to more than one pollutant. When AQI values are between 101 and 150, members of sensitive groups may experience health effects. The general public is not likely to be affected when the AQI is in this range.
"Unhealthy" AQI values are between 151 and 200. Everyone may begin to experience health effects. Members of sensitive groups may experience more serious health effects.
"Very Unhealthy" AQI values between 201 and 300 trigger a health alert, meaning everyone may experience more serious health effects.
"Hazardous" AQI values over 300 trigger health warnings of emergency conditions. The entire population is more likely to be affected.

How is the Air Quality Index Calculated?

An index, AQI, for any given pollutant is its concentration expressed as a percentage of the relevant limit value or standard:

$$AQI = \frac{\text{Pollutant concentration}}{\text{Pollutant limit value}} \times 100$$

An index value greater than 100 means the pollutant has exceeded the relevant air quality limit value or standard. Air quality limit (AQL) values have been established for Egypt since 1994 (EEAA, 1994). The limit values especially for PM_{10} have been discussed several times (Sivertsen and Dreiem, 2002) and new standards were proposed in 2002 as shown in Appendix G1 of Mission 04 report (Sivertsen and Dreiem, 2004b).

To assess the overall air quality at a particular monitoring station, an index is calculated for each measured pollutant. The maximum of these figures is taken to be the Air Quality Index for that monitoring station as it represents the worst of the pollutants measured. The worst site is then used to summarise the air quality of Cairo

Proposed daily index

As part of the daily reporting of air quality in Cairo (Sivertsen, 2004a) we proposed to develop a simplified air quality index (AQI) for characterising the air inside the city centre. A selection of four representative stations in the city centre of Cairo could form the basis for this index:
Quolaly, FumAlKhalig, Gemoria and Abbaseya.

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

The hourly sub index, I^h_j, for a given day at the station j is calculated as:

$$I^h_j = Max_{day}(Max_i(C^h_{i,j}/S^h_i)) * 100$$

where
$C^h_{i,j}$ is the hourly average concentration for the specie i at the station j and
S^h_i is the hourly Air Quality Standard for the specie i.

PM_{10} is not included in the calculation of I^h_j as the S for PM_{10} is only given for 24 hour average.

The handling of PM_{10} concentrations in the AQI for Cairo may represent a problem, as the background concentrations are normally very high. We thus suggested that the new proposed 24 hour average value for PM_{10} at 150 &g/m^3 is being used when producing the daily AQI value.

The daily index, AQI^d_j, is calculated as:

$$AQI^d_j = Max_i(C^d_{i,j}/S^d_i) * 100$$

where $C^d_{i,j}$ is the daily average concentration for the specie i at the station j and S^d_i is the daily Air Quality Standard for the specie i. In this case also PM_{10} is included in the evaluation!

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

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

Typical AQI values may be generated automatically using the proposed database and assessment system AirQUIS.

Classification developed for the forecast system

Air pollution forecast system is also operated for EEAA based on evaluations of PM_{10} concentrations measured in the greater Cairo area (El-Shahawi, 2001).

The procedures have been based on a sequence of evaluations:

- The starting point is to forecast the same level as at 18:00 hrs the day before
- If stabilising atmospheric surface conditions prevails for more than 16 hours and wind speeds are less tan 2.5 m/s high pollution level is forecasted
- Wind trajectories are calculated and presented in a map
- The sources for air pollution are located in the south: Helwan cement factories, Tabbin industries, in the north: Industries in Soubra and Kaliobeia, burning in the Delta, in the east: Garbage areas, Salem city, Katameia etc., local sources inside the city such as waste burning, traffic, small enterprises etc.

The table below has been developed for internal awareness of air pollution in Cairo based on weather forecast procedures and evaluation of the PM_{10} concentrations only. The table indicate PM_{10} levels to look for when classifying the air from "clean" to "emergency". In the forecast procedures these PM_{10} concentrations represent typical 8-hour average concentrations

Classification based on PM_{10} concentration	
PM_{10} (µg/m^3)	**Classification**
0 to 99	Clean
100 to 199	Normal
200 to 349	Moderate
350 to 419	Attention
420 to 549	Alert
550 to 649	Warning
above 650	Emergency

EEAA scheme compared to USEPA AQI

In the following discussion we have compared and evaluated the EEAA classification scheme relative to the USEPA AQI classification. We have converted the EEAA classification PM_{10} concentrations based on 8-hour average concentrations to a similar 24-hour average (based on long term measurements in Cairo). Further we have generated AQI values based on the proposed new air quality limit value for Egypt at 150 µg/m^3 as a 24-hour average.

EEAA classific.	PM10 concentration (µg/m3)		AQI	USEPA classification	Color
	8-h aver	24h			
Clean	99	71	47	good	green
Normal	200	143	95	Moderate	yellow
Moderate	350	250	167	Unhealthy to sensitive	orange
Attention	420	300	200	Unhealthy	red
Alert	550	393	262	Unhealthy	red
Warning	650	464	310	Very unhealthy	purple
Emergency	above 650		above 310	Hazardeous	maroon

We see that the “moderate” class given in the EEAA scheme would give “unhealthy to the sensitive population” in the US EPA scheme. At “unhealthy” classes in the EPA scheme EEAA will give “attention” and “Alert”. Otherwise there is consistency between the scheme developed for internal awareness at EEAA and the internationally recognised air quality index systems used for public information.

Air Quality Index (AQI) for particulate matter and public information

In cases where PM_{10} is used as the critical component for indexing air pollution the following table has been developed as cautionary statements in the information to the public.

Index Values	Levels of Health Concern	Cautionary Statements*	
		$PM_{2.5}$	PM_{10}
0 - 50	Good	None	None
51 - 100**	Moderate	None	None
101 - 150	Unhealthy for Sensitive Groups	People with respiratory or heart disease, the elderly, and children should limit prolonged exertion.	People with respiratory disease, such as asthma, should limit outdoor exertion.
151 - 200	Unhealthy	People with respiratory or heart disease, the elderly, and children should avoid prolonged exertion; everyone else should limit prolonged exertion.	People with respiratory disease, such as asthma, should avoid outdoor exertion; everyone else, especially the elderly and children, should limit prolonged outdoor exertion.
201 - 300	Very Unhealthy	People with respiratory or heart disease, the elderly, and children should avoid any outdoor activity; everyone else should avoid prolonged exertion.	People with respiratory disease, such as asthma, should avoid any outdoor activity; everyone else, especially the elderly and children, should limit outdoor exertion.
301 - 500	Hazardous	Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly, and children should remain indoors.	Everyone should avoid any outdoor exertion; people with respiratory disease, such as asthma, should remain indoors.

PM has two sets of cautionary statements, which correspond to the two sizes of PM that are measured:

- Particles up to 2.5 micrometers in diameter ($PM_{2.5}$)
  Particles up to 10 micrometers in diameter (PM_{10})
- An AQI of 100 for $PM_{2.5}$ corresponds to a $PM_{2.5}$ level of 40 micrograms per cubic meter (averaged over 24 hours).
  An AQI of 100 for PM_{10} corresponds to a PM_{10} level of 150 micrograms per cubic meter (averaged over 24 hours).

What are the health effects and who is most at risk?

Both fine and coarse particles can accumulate in the respiratory system and are associated with numerous health effects. Coarse particles can aggravate respiratory conditions such as asthma. Exposure to fine particles is associated with several serious health effects, including premature death. Adverse health effects have been associated with exposures to PM over both short periods (such as a day) and longer periods (a year or more).

When exposed to PM, people with existing heart or lung diseases—such as asthma, chronic obstructive pulmonary disease, congestive heart disease, or ischemic heart disease—are at increased risk of premature death or admission to hospitals or emergency rooms.

The elderly also are sensitive to PM exposure. They are at increased risk of admission to hospitals or emergency rooms and premature death from heart or lung diseases.
When exposed to PM, children and people with existing lung disease may not be able to breathe as deeply or vigorously as they normally would, and they may experience symptoms such as coughing and shortness of breath.

PM can increase susceptibility to respiratory infections and can aggravate existing respiratory diseases, such as asthma and chronic bronchitis, causing more use of medication and more doctor visits.

Conclusions

We will recommend that the AQI system developed for EEAA is harmonised and used in the future for classifying the air quality, especially in Cairo, in an objective and systematic way.
This memo will thus be open for further discussions.

References

EEAA (1994) Maximum limits for outdoor air pollutants, as given by Annex 5 of the Law number 4 for 1994, Law for the Environment, Egypt. Cairo, Egyptian Environmental Affairs Agency.

El-Shahawi M.A. (2001). Prediction of air pollution episodes. Research note. Boundary Layer Meteorology, 104: p. 319-329. 2002.

Sivertsen, B. and Dreiem R. (2003) DANIDA. EIMP phasing-out phase, 2003-2004. End of mission report, air quality monitoring, mission 02, May-June 2003, Appendix F2. Kjeller (NILU OR 41/2003)

Sivertsen B. (2004a) Daily reports. Memo EIMP, Cairo 24 September 2004-09-28

Sivertsen B (2004b) AppF: Air quality in Egypt and App. G Proposed new air quality limit values. In: EIMP Phasing-out Phase 2003-2004, End of Mission Report, Air Quality Monitoring, Mission 04, March 2004. Kjeller, (NILU OR 50/2004)

Appendix D4: June 2004 Report

Environmental Information and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

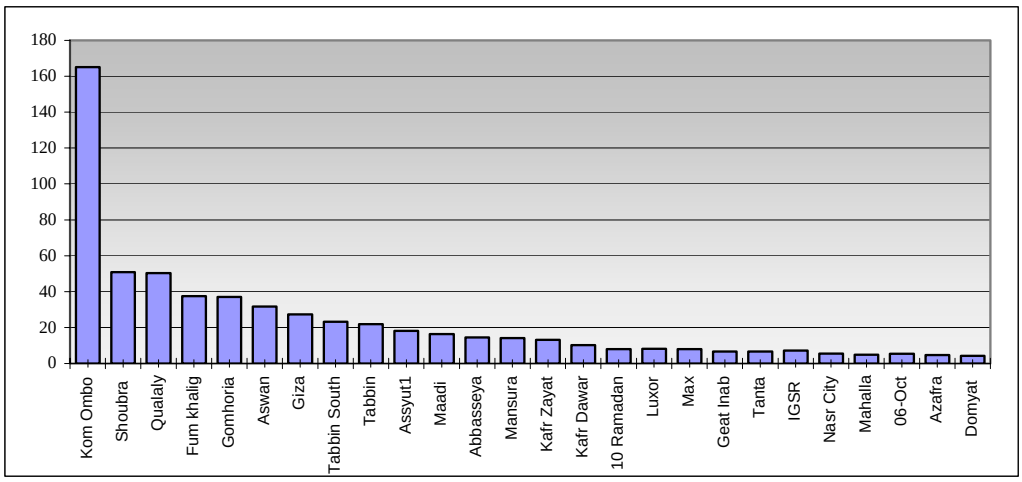
Date: **23 September 2004**
To: EIMP Phase out
From: **Bjarne Sivertsen, Ashraf Saleh and Haytham Ahmed**

Monthly report June 2004- Summary

Introduction

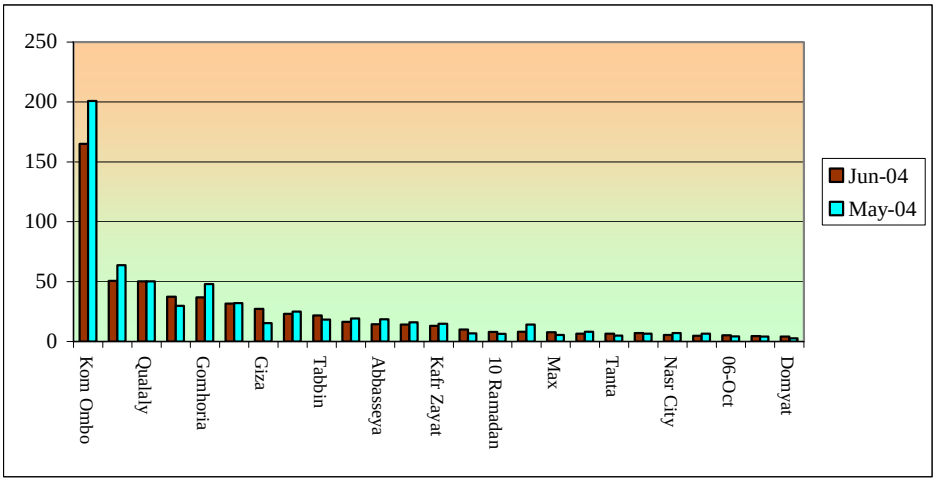
The following short summary and comments have been based on the monthly report for June 2004 prepared by Ashraf Saleh. The report was originally prepared in Arabic language.

SO_2 concentrations



Monthly average SO_2 concentrations at all sites in Egypt, June 2004

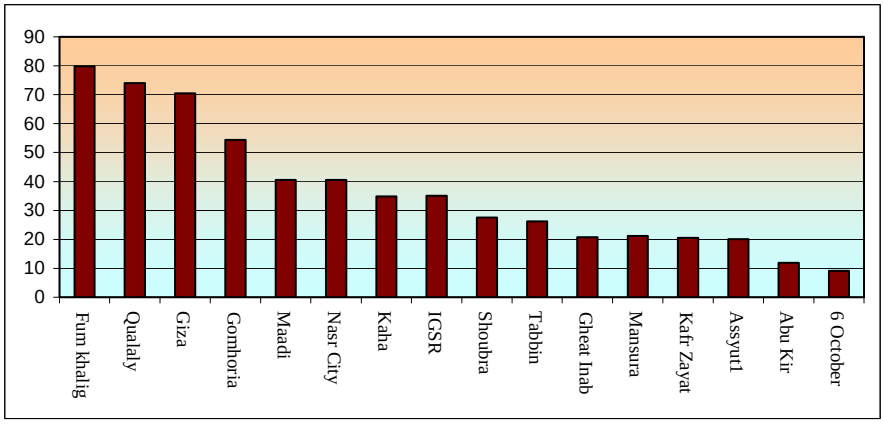
Exceedance of 60 µg/m^3 (annual average AQL) was found in at Komombo. The data from Maadi, however, has been questioned and is being studied in more details. The monthly average concentrations at Shoubra ElKheima and Quolaly were between 40 and 60 µg/m^3. The typical monthly average concentrations of SO_2 ranged between 30 and 50 µg/m^3 in the greater Cairo area.



Monthly average SO_2 concentrations measured in June 2004 compared to concentrations of May 2004.

Concentrations at the most impacted sites were all lower in June than in May 2004. The data from Shoubra, which normally is one of the most impacted sites, were not available in June.

NO_2 concentrations

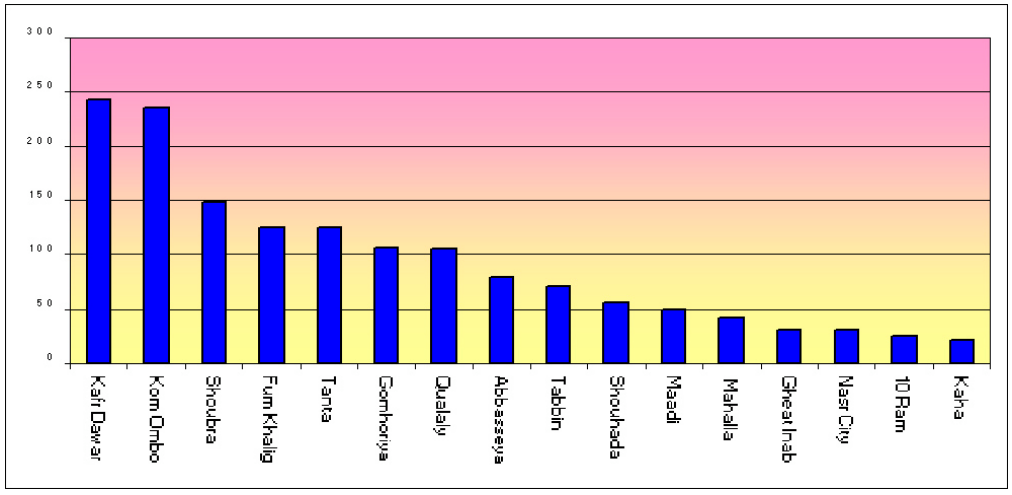


Monthly average NO_2 concentrations from 16 sites in Egypt, June 2004

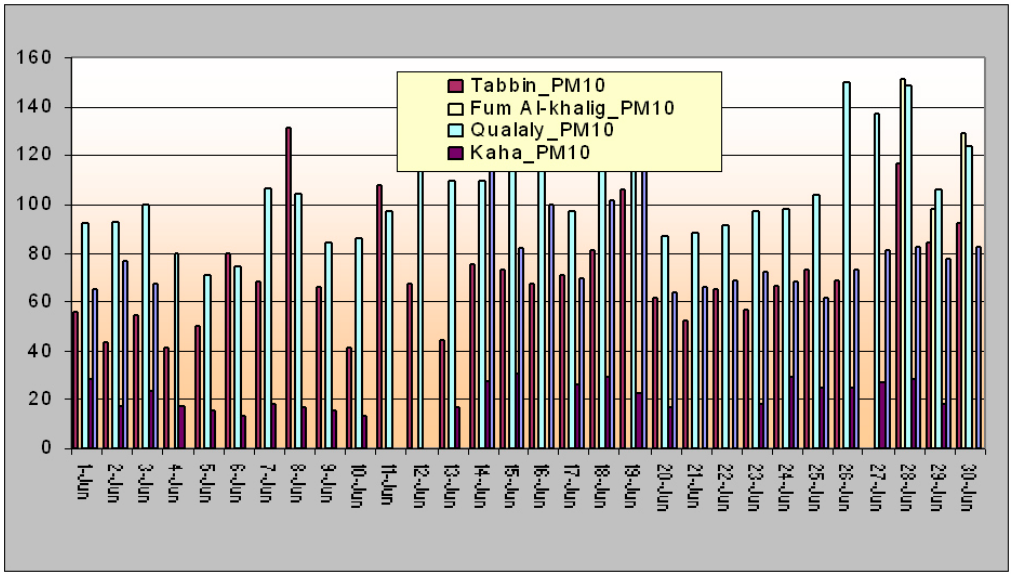
NO_2 concentrations were on the average highest in the city centre of Cairo with monthly average concentrations ranging between 60 and 80 µg/m^3. The city centre site in Alexandria had NO_2 concentrations giving a monthly average of 35 µg/m^3.

PM_{10} concentrations

PM_{10} concentrations are exceeding national and international air quality limit values at all sites in Egypt. The data from Kafr Dawar, KomOmbo, Shoubra, FumAlKhalog and Tanta had monthly average PM_{10} concentrations of more than twice the 24-hour average limit value of 70 µg/m^3.



Monthly average PM_{10} concentrations measured during June 2004.



Daily average PM_{10} concentrations at 4 sites in the greater Cairo area.

The daily average concentrations of PM_{10} are presented for December 2003 in the following Figure.

Only on a few days the 24-hour average PM_{10} concentrations exceeded 140 µg/m^3 at the sites in Cairo city centre, which is twice the AQ limit value of 70 µg/m^3 .

Summary of June 2004 data

Maximum one-hour average concentrations for June 2004 are presented in the following table.

	CO**	Ozone	PM10	NO2	SO2
1. Kolaly			252	131	176
2. Gomhorya	12			159	189
3. Abbassya		159	211		118
5. Maadi x)				161	68
6. Tabbin			397	131	89
8. Fum Khalig	8		171	180	125
10. Shoubra El K					352
11 Giza		210		133	107
12. Kaha			69	108	
15. Suez		226			110
20. Assuyt1					
30. Shouhada				144	49
35. Kafr Zayat				51	465
37. Mahalla			456		8
38. Mansura				100	29
Limit value	**30**	**200**	**-**	**400**	**350**

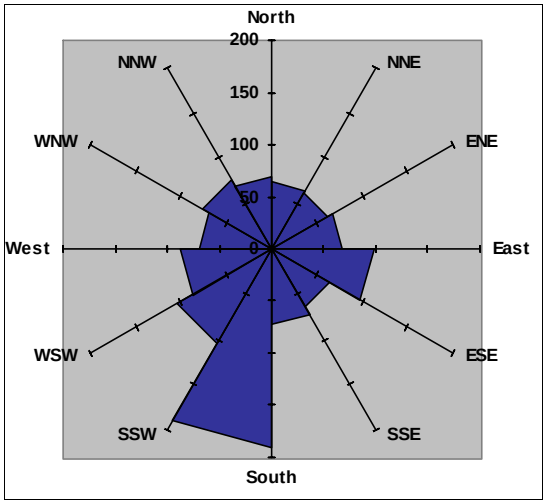
x) malfunctions at the station?

PM_{10} concentrations were as always high. However some of the PM_{10} monitors did not work properly throughout the whole month.

SO_2 concentrations exceeded the air quality limit value at Shoubra El-Kheima and Kafr Zayat in June 2004.

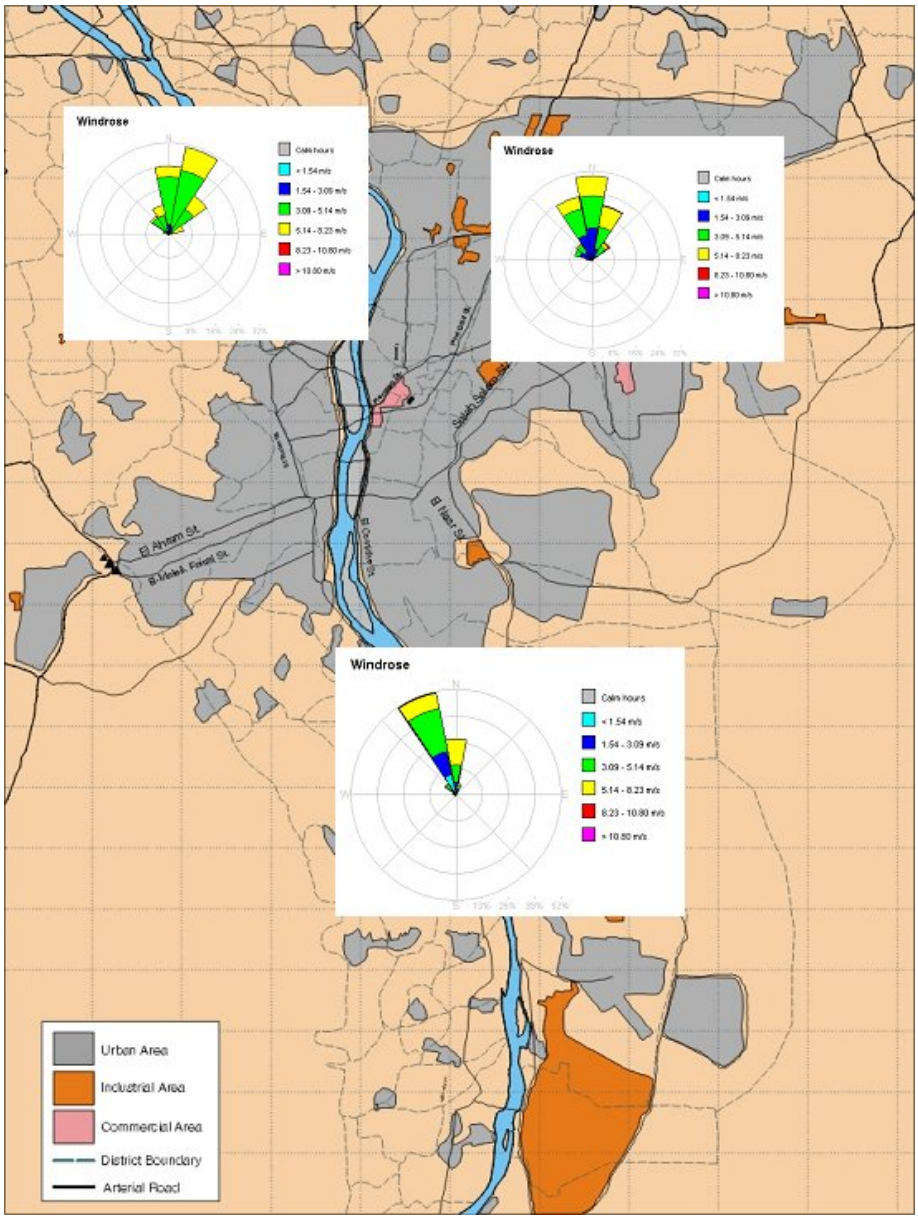
PM_{10} as function of wind directions

The average PM_{10} concentrations as functions of wind directions are shown in the next figure (Breuer diagram) for measurements at Tabbin in June 2004.



Breuer diagram for PM_{10} concentrations at Tabbin station

The highest concentrations of Pm10 occurred for wind from around south south west. As seen below these wind directions occurred very rarely during June. The impact may be caused by emissions from the power plant and the smelters located south of the site at Tabbin.



Wind roses for three sites in Cairo, June 2003.

Winds from around north were domination in Cairo during June 2004.

Appendix D5: High AQ October 2004

Environmental Information and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **2 October 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed (HAA), Ashraf Saleh Ibrahim(ASI)
From: **Bjarne Sivertsen (BS)**

High nighttime air pollution

Introduction

Periods of high air pollution levels have been observed frequently during the last few years in Cairo due to high emissions of air pollutants from different sources combined with specific meteorological conditions. Air pollution episodes have most frequently been observed during the month of October as a combination of near calm conditions, strong surface based inversions and additional input of air pollutants from burning of waste and in some cases agricultural waste north of Cairo (in the Delta).

PM_{10} after midnight 1 October 2004

A short-term high peak concentration occurred after midnight on 1 October 2004. Wind trajectories indicated winds from the north. The PM_{10} concentrations at Abbaseya rose to about 500 µg/m^3 for a few hours between 03 and 07 hrs in the morning of 1 October.

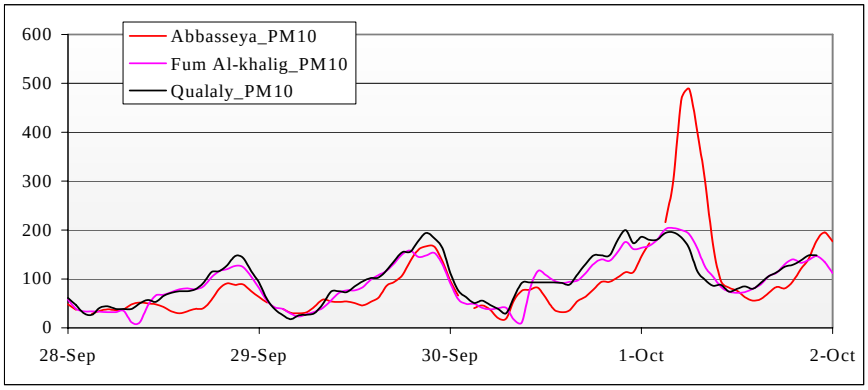


Figure 1: PM_{10} concentrations measured at 3 sites from 28 Sep to 2 Oct 2004.

If we look closer to the night of 1 October we wee that only the PM_{10} concentrations at Abbaseya increased to levels much higher than normal. The PM_{10} monitor at Kaha did not work this day, so we cannot check whether this plume of PM_{10} came from the Delta or it was a local source.

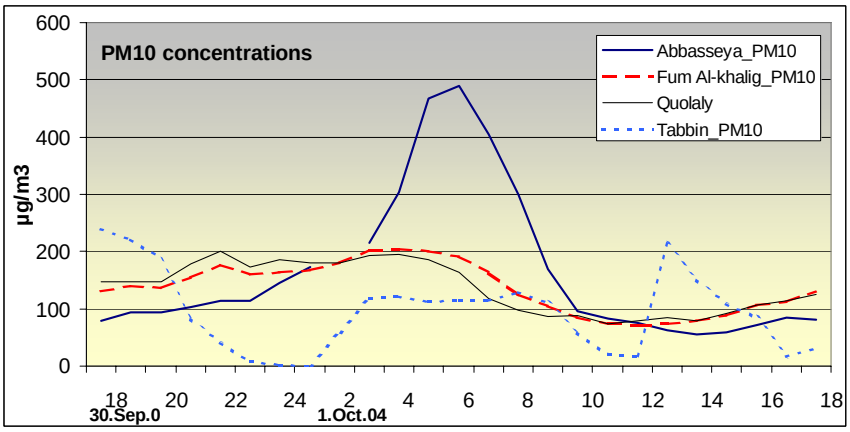


Figure 2: PM_{10} concentrations at 4 sites on 30 Sep and 1 Oct 2004

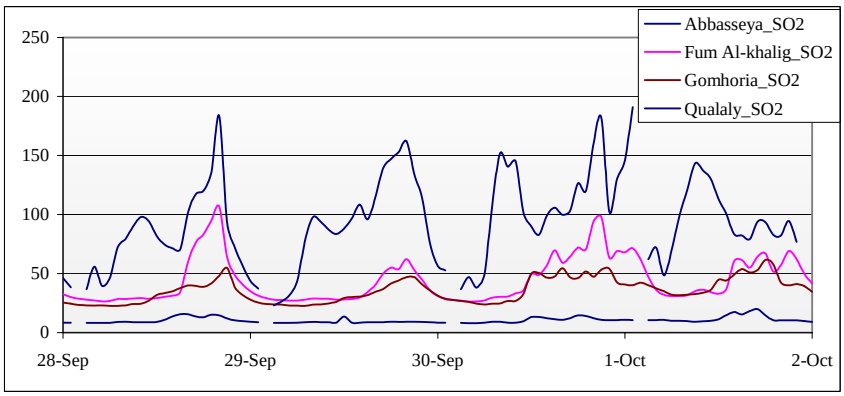


Figure 3: SO_2 concentrations measured at 4 sites in Cairo on 28 Sep to 12 Oct 2004

When analysing the data from the other stations as well as the SO_2 concentration below there are reasons to believe that some very local burning near the Abbasseya station (north of it) causes these high PM_{10} concentrations.

The high SO_2 concentrations are only recorded at Quolaly. This is normal and the highest levels occur in the evening. The reason for this is that after sunset the surface atmosphere become very stable (inversion) and the air pollution released at the surface will stay there and create high concentrations when the wind speed is low.

Also the measurements of NO_2 indicate this pattern. However, NOx is mainly related to traffic emissions. The diurnal variation is thus closely related to the traffic density variation. Figure 4 also indicates highest concentrations in the evening.

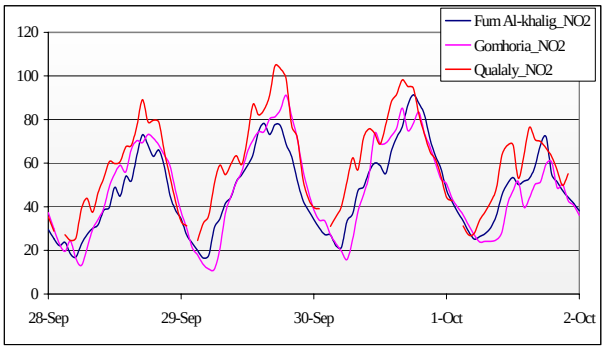


Figure 4: NO_2 concentrations at 3 sites in Cairo

Where did PM come from?

When analysing the meteorological data from Abbaseya we see that we have a well-defined wind from the north at 2 to 3 m/s from midnight.

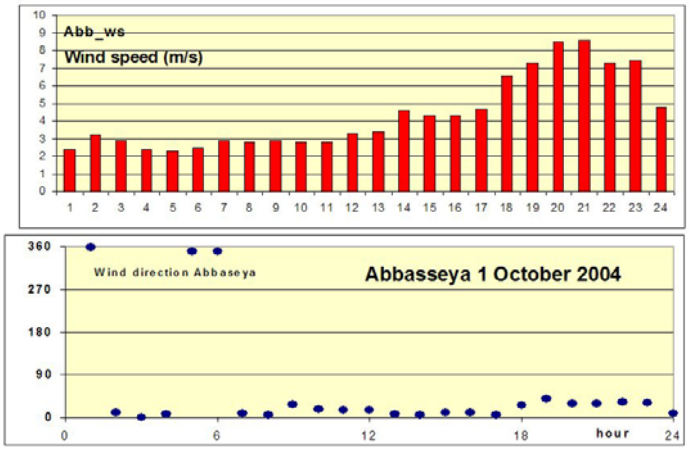


Figure 5: Wind speeds and wind directions measured at Abbasseya on 1 October 2004.

This means that the pollution measured at Abbasseya (particulates) must have originated north of the site. It must have been well-defined plumes originating from point sources or may be burning at the surface. The sources may not have been tens of kilometres away, otherwise also Quolaly and other sites would have been impacted. This was not the case. The map below indicates the sector from which the particles could have originated.

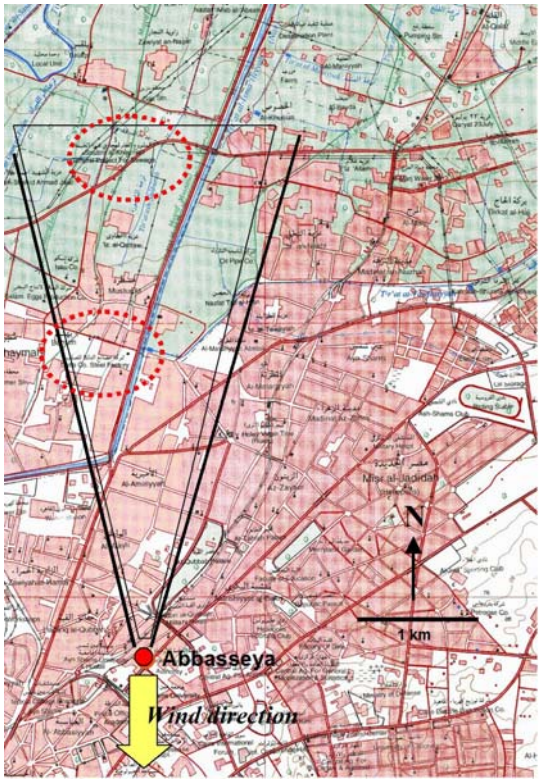


Figure 6: Potential source areas for impact at Abbasseya on 1 October 2004

Average diurnal variation

The average diurnal variation of PM_{10} during the 3 days from 28 September to 2 October also shows a pattern, which is different from what we normally see.

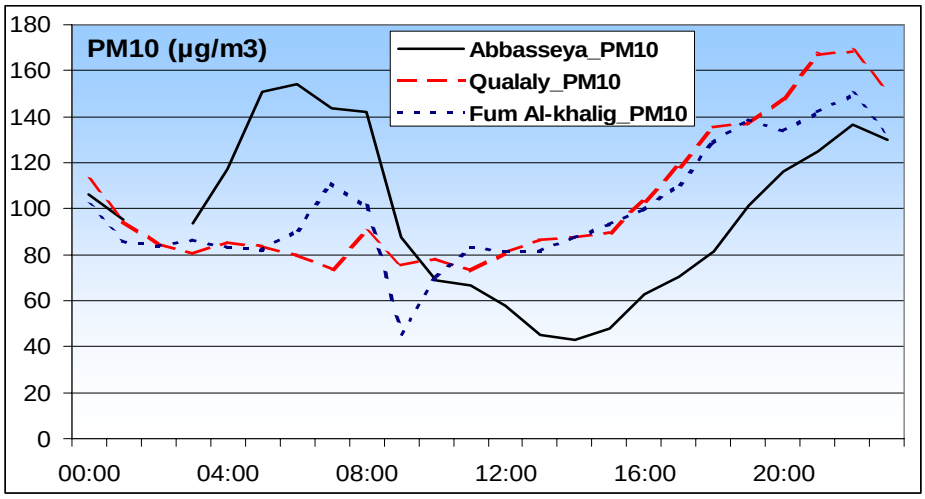


Figure 6: Average diurnal variation of Pm10 at 3 sites from 28 Sep. to 2 Oct. 2004

The Abbasseya PM_{10} concentrations are influenced by the nighttime impact, while a secondary rise of PM_{10} occurs at Abbaseya and Fum Al-Khalig when the morning rush hours start at 07:00 hrs. After noon there was an increase in PM_{10} concentrations at all sites, which lasted till 22:00 hrs (late evening).

Also NO_2 and SO_2 concentrations show this steady increase in concentrations from early morning till late afternoon, as seen in Figure 7.

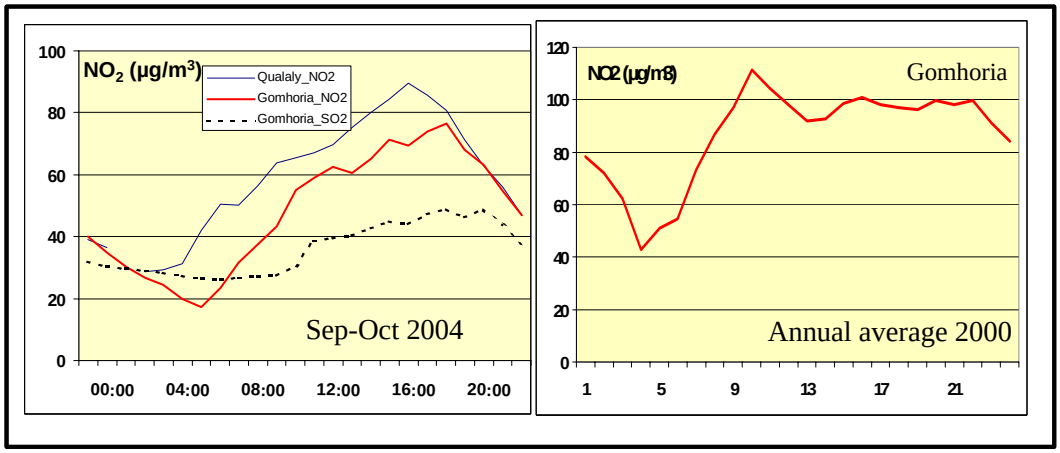


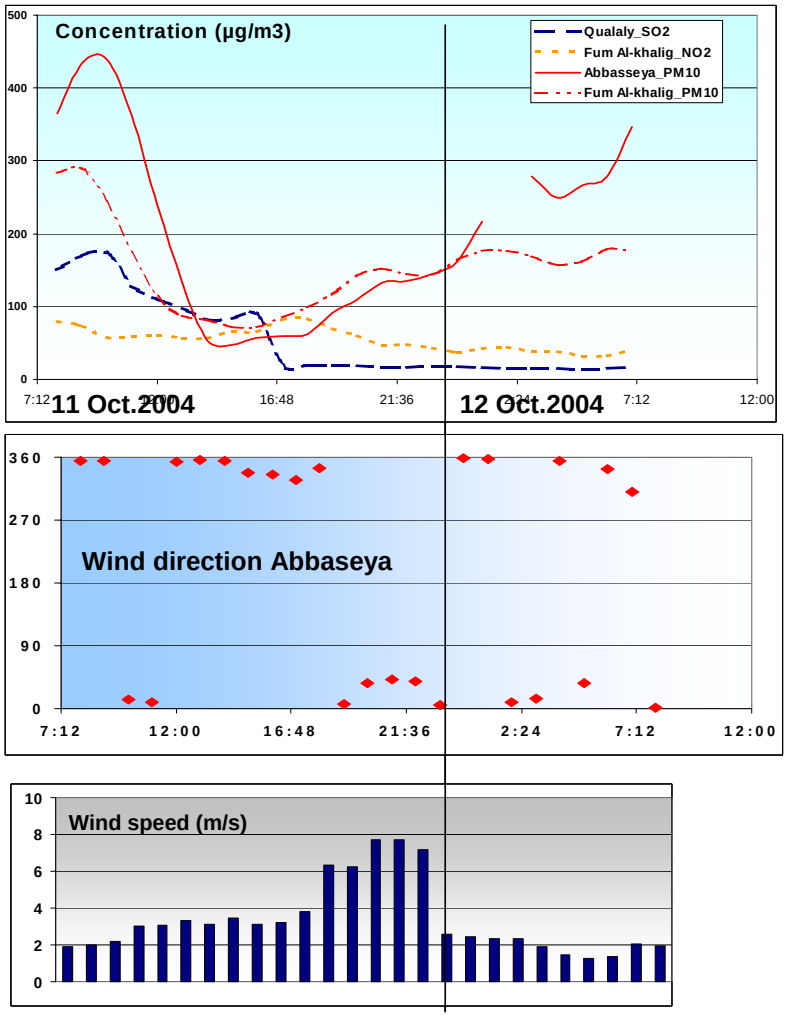
Figure 7: Average diurnal variation of NO_2 (and SO_2) during a) 28 Sep to 2 Oct 2004 compared to the average diurnal variation of NO_2 at Gomhoria during the year 2000.

The average diurnal variations in all pollutants were different during the last days of September 2004 than normally shown in the data. The reasons for this have not yet fully been explained. A combination of variable sources (activities after dark?) and meteorological conditions; strong surface inversions after sunset, may be some of the reasons.

Appendix D6: High PM_{10} from burning in the Delta

Memo 12 October 2004
Bjarne Sivertsen

High PM_{10} concentrations from burning in the Delta

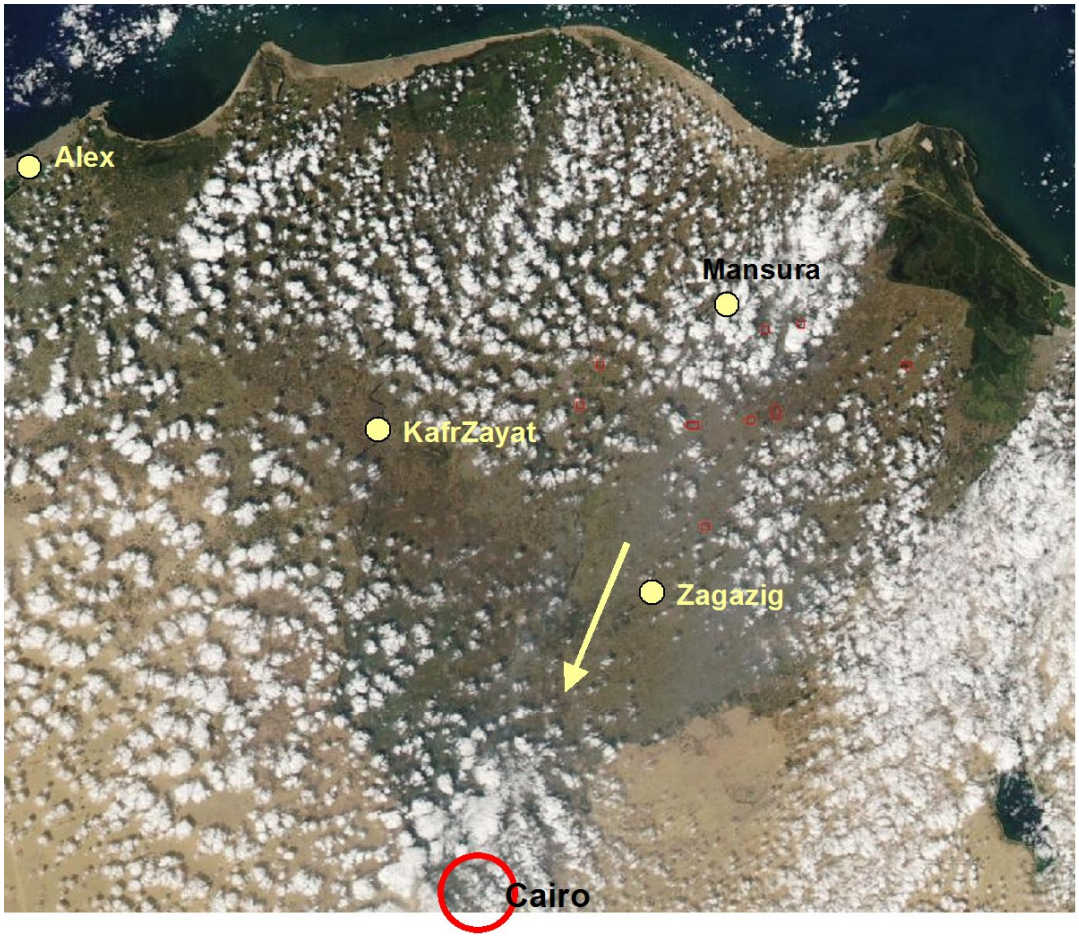


On 11 to 12 October 2004 very high concentrations of PM_{10} were recorded at Abbaseya and at Fum-AlKhalig in Cairo. The winds were from the north at 2 m/s at night and in the morning hours. A cloud of particles passed Cairo as seen from the Abbaseya measurements between 0700 and 1100 hrs. Also SO_2 at Quolaly exceeded 150 µg/m^3.

The wind speed increased to 3-4-m/s during the day, and increased again to 7-8 m/s in the evening. After sunset the PM_{10} concentration picked up again in the city

center due to activities and transport at the surface. Around midnight the wind speed was reduced to 2 m/s an after a few hours during the night another cloud of particles moved in across Abbasseya.

Satellite photos indicated that there was burning of agricultural wastes in the Delta as shown in the Figure below.



Satellite photo taken over the Nile Delta on 11 October 2004 at 10:00 hrs.

Plumes of dust were also observed moving into Cairo in the morning of 11 October 2004. In the afternoon high dust levels were observed west of Maadi.

This pattern was observed several days in October 2004. To identify the importance of the burning of agricultural waste in the Delta compared to the number of local sources inside Cairo, we may have to analyze a selection of filters collected during the days of interest.

Appendix D7: PM annual variation

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Phasing out Phase
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Memo

Date: **24 September 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed (HAA), Ashraf Saleh Ibrahim(ASI)
From: **Bjarne Sivertsen (BS)**

Annual variation of PM_{10} in greater Cairo

PM_{10} concentrations measured based on the CAIP network was analysed to study the typical annual variation in PM_{10} concentrations in greater Cairo.

The uncritical use of all data available from 21 sites from 1999 to 2003 show in Figure 1 that there is not a consistent annual variation in the average PM_{10} concentrations.

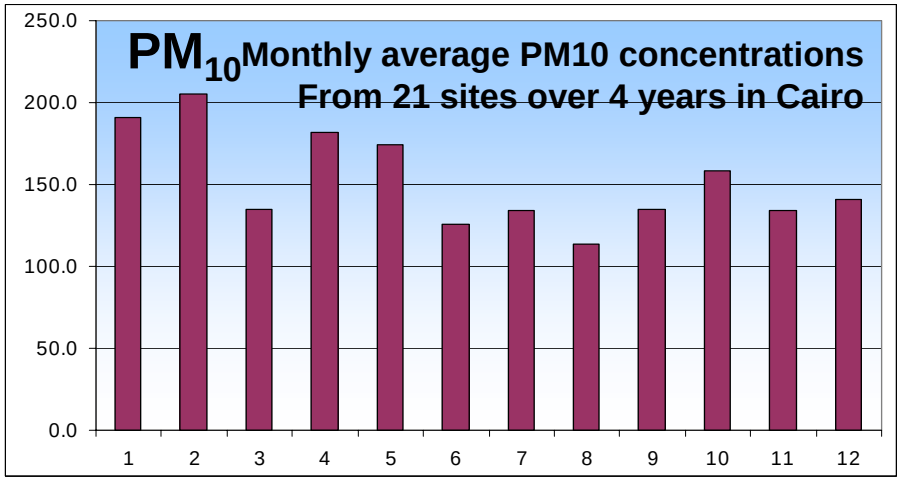

Figure 1: Monthly average concentrations of PM_{10} based on data from 21 sites from 1999 to 2003 in Cairo.

However, the months of January and February had 60 % higher concentrations than the months from June to August.

The data were re-analysed to only select data sets where we had complete series of data. This selection gave us PM_{10} data from 5 sites inside the city centre of Cairo. Figure 2 shows a slightly different distribution than Figure 1.

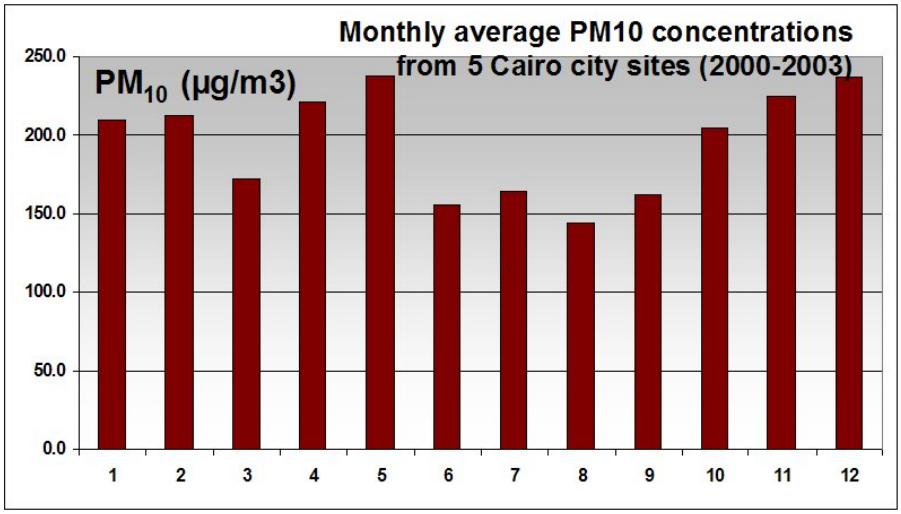

Figure 2: Monthly average concentrations of PM_{10} based on data from 5 sites inside the city centre of Cairo (data from 1999 to 2003)

The highest average PM_{10} concentrations were measured in the months of May. December and November. Generally we see that the PM_{10} concentrations in Cairo are lower in the summer months from June to September than in the winter months. The high concentrations observed in April and May might be caused by a few days of very high concentrations related to the Khamsin sand storms.

The monthly average PM_{10} concentration levels as observed by the CAIP AirMetrics station network ranged between 150 and 230 µg/m^3. This a long term average level, which we do not find in many areas of the world. The conclusion is that Cairo is probably one of the most polluted cities in the world when suspended particulate matter is concerned.

Appendix E

A national Air Quality Network

Appendix E1: National AQ Network

Environmental Information and Monitoring Programme
Phasing out Phase
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Memo

Date: **3 October 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: HAA, ASI, Tarek, ElSayed, Hani
From: **Bjarne Sivertsen (BS)**

Planning the national air quality network for EEAA, Egypt

Objective

An overall objective of the air quality measurement programme is to obtain a better understanding of the urban and residential air pollution as a prerequisite for finding effective solutions to air quality problems and for sustainable development in the urban environment.

Further it will be important to identify areas where the Air Quality Limit values are exceeded and to identify possible actions to reduce the pollution load and to improve the general environmental conditions of the country.

The main purpose of the air quality measurements will be to identify the possible exposure to the public and to people in general. Information will be collected on ambient air pollution levels in areas where people live and work. The measurements will cover areas of impact from various sources of pollution.

To enable evaluation and assessments of air quality and to enable trend analyses a network of **fixed stations** isneeded. There are international rules for estimating the minimum number of sampling points for fixed measurements to assess the compliance with limit values for the protection of human health.

Site considerations

The following considerations are sited from the European Air Quality Daughter Directives and relates to fixed measurement points directed at the **protection of human health** (Macro scale siting).

Sampling should be sited to:

1. Provide data on the areas within polluted areas or urban agglomerations where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value(s);
2. Provide data on levels in other areas within the agglomerations, which are representative of the exposure of the general population.
3. Avoid measuring very small microenvironments in their immediate vicinity. As a guideline, a sampling point should be sited to be representative of air quality in a surrounding area of no less than 200 m^2 at traffic-orientated sites and of several square kilometres at urban-background sites.

The information shall be available in such a form that it is suitable to:

- Facilitate a general description of air quality, and its development over time (trend);
- Enable comparison of air quality from different areas and countries;
- Produce estimates of exposure of the population, and of materials and ecosystems;
- Estimate health impacts;
- Quantify damage to materials and vegetation;
- Support development of cost-effective abatement strategies;
- Support legislation (in relation to air quality directives);
- Influence/inform/assess effectiveness of future/previous policy.

Indicators and measurement techniques

Measurement techniques should be reasonably accurate and within an acceptable cost. The effect of indicators on health impact, building deterioration, vegetation damage, etc., should be adequately documented and linked to public awareness. Selected indicators should respond to mitigation actions to prevent manmade negative impacts on the environment.

The most commonly selected air quality indicators for urban air pollution are:

- Nitrogen dioxide (NO_2),
- Sulphur dioxide (SO_2),
- Carbon monoxide (CO),
- Particles with aerodynamic diameter less than 10 μm (or 2,5 μm), PM_{10} ($PM_{2,5}$),
- Ozone.

Most of these indicators have been identified in the air quality limit values as presented in the Law no. 4 for Egypt. Based on impact to public health some selected air quality guideline (AQG) values for most of these indicators have also been presented by the World Health Organisation (WHO, 1987 and 1995)

In the European EUROAIRNET programme priority indicators have been selected for different types of impact to the environment. A summary of the first priority pollutants as given by the European Environmental Agency (EEA) is presented in the Table below.

Priority pollutants included in the urban air quality monitoring programmes

No.	ISO-Code[9]	Formula	Name of pollutant	Units of measurement	Average over
1.	01	SO_2	Sulphur dioxide	µg/m³	1 h
2.	03	NO_2	Nitrogen dioxide	µg/m³	1 h
3.	24	PM10	Suspended particulates (< 10 µm)	µg/m³	24 h
4.	39	PM2.5 [14]	Suspended particulates (< 2.5 µm)	µg/m³	24 h
5.	n.a.[15]	PM1	Suspended particulates (< 1 µm)	µg/m³	24 h
6.	22	SPM	Suspended particulates (total)	µg/m³	24 h
7.	19	Pb	Lead	µg/m³	24 h
8.	08	O_3	Ozone	µg/m³	1 h
9.	V4	C_6H_6	Benzene	µg/m³	24 h
10.	04	CO	Carbon monoxide	mg/m³	1 h

Priorities for Egypt

A list of priorities will have to be prepared for keeping up an air quality network for EEAA that will meet the most urgent needs and at the same time meet the international requirements for quality and standard.

Such a list will include:

- Indicators (or compounds)
- Measurement methods
- Sites and areas to monitor
- Data retrieval system
- Data dissemination

The most important **indicators** for air pollution in Egypt, when related to international guidelines and standards are particulate matter (PM). The network of continuous on-line monitors as well as the manually operated AirMetrics network will have to be considered as one total system.

The second priority pollutants will be NO_2, ozone, SO_2 and CO (in that sequence). Other indicators such as BTX could be introduced in the future, while PAH and other organic compounds may be measured intermittently and not on a continuous basis.

The most important sites are located in the Cairo area. For the daily information and data dissemination system we have selected 4 sites: Quolaly, Gomhorya, FumAl-Khalig and Abbaseya. PM10 and ozone should also be recorded from Kaha.

It will be important to Maintain good quality on-line data from a selected number of sites in the greater Cairo area. For the rest of Egypt we have considered to keep up sites such as ElShouhada and regional ozone in Alexandra and the site in KafrZayat. Meteorological stations such as Abbasseya, Kaha, Tabbin and IGSR are important for understanding the air quality measured.

Update existing network

Some of the existing sites developed as part of the EIMP programme as well as the network established for the CAIP programme has been evaluated. Other sites have also been considered as part of the new updated national monitoring programme for EEAA.

Several proposals have been discussed for the measurements in Alex and the Delta region. We have inspected some possibilities in the Alexandria region, but final decisions for changes have not been approved by EEAA.

The main objectives will have to sustain a network according to the main objectives and the priorities given by EEAA. Some priorities was discussed in the chapter above.

QA/QC system sustained and updated

It is important for the operations of a monitoring network to include a comprehensive QA/QC programme to assure that the monitors are actually providing concentrations within the required level of uncertainty, and that malfunctions and errors are detected and corrected.

It will be necessary to develop and implement a complete QA/QC system for the operational level of the air quality monitoring programme. Complete documentation will have to be established, which explains in detail how to perform and record all operations necessary to run, maintain and calibrate the instrumentation both in the laboratory and in the field. The procedures are supposed to be used by the operators in their daily work.

The Audit functions developed for the Reference Laboratory will have to be upgraded, and the importance of obtaining the necessary calibration gases and calibration standards related to international requirements is of utmost importance.

Databases

The development of an associated database is important to all modern environmental monitoring and information systems. The data base system may consist of several databases, which serve as main storage platforms for:

- On-line collected ambient air quality data,
- Calculated fields of emissions, concentrations and exposure,
- Historical data with trends, background information (land use, population distributions),
- National and international regulations, air quality limits or guideline values,
- Information on the support and decision-making processes.

The databases contain information that enables an evaluation of the actual state of the environment and it includes data for establishing trend analyses, warnings and the undertaking of countermeasures in case of episodic high pollution.

The application and use of the air quality data collected by the EIMP as well as for the CAIP programme has been discussed in several meetings at EEAA. It is desired to develop one common GIS based database, which integrate measurements, emission data and models for assessment and planning into one system.

A possible approach to meet these questions will be to start preparing the tools for performing an air quality management planning system to prepare an extensive assessment study and to prepare a master plan for air quality in Cairo. The tools for such planning including optimal abatement strategy planning are available.

One such system that meets the requirements of modern air quality assessment is the AirQUIS system, which was developed by the Norwegian Institute for Air Research (NILU) (www.NILU.no) to handle a number of air pollution tasks and challenges. It is based on a Geographical Information System (GIS). The main objective of a modern environmental surveillance platform like AirQUIS is to enable direct data and information transfer and obtain a remote quality control of the data collection.

Questions to be answered

A best possible definition of the air pollution problem together with and analysis of available personnel, budget and equipment represent the basis for decision on the following questions:

10. What spatial density of sampling stations is required?
11. How many sampling stations are needed?
12. Where should the stations be located?
13. What kind of equipment should be used?
14. How many samples are needed, during what period?
15. What should be the sampling (averaging) time and frequency?
16. What other than air pollution data are needed:
    - Meteorology,
    - Topography,
    - Population density,
    - Emissions,
    - Effects and impacts, etc.?
17. What is the best way to obtain the data (configuration of sensors and stations)?
18. How shall the data be communicated, processed and used?

The answers to these questions will vary according to the particular need in each case. Most of the questions will have to be addressed in the site studies discussed in the next chapter.

Appendix E2: CAIP sites

Environmental Information
and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
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Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **5 October 2004**
To: Ahmed Abou Elseoud (AAE)
Copy: Haytham Ahmed (HAA),
From: **Bjarne Sivertsen (BS)**

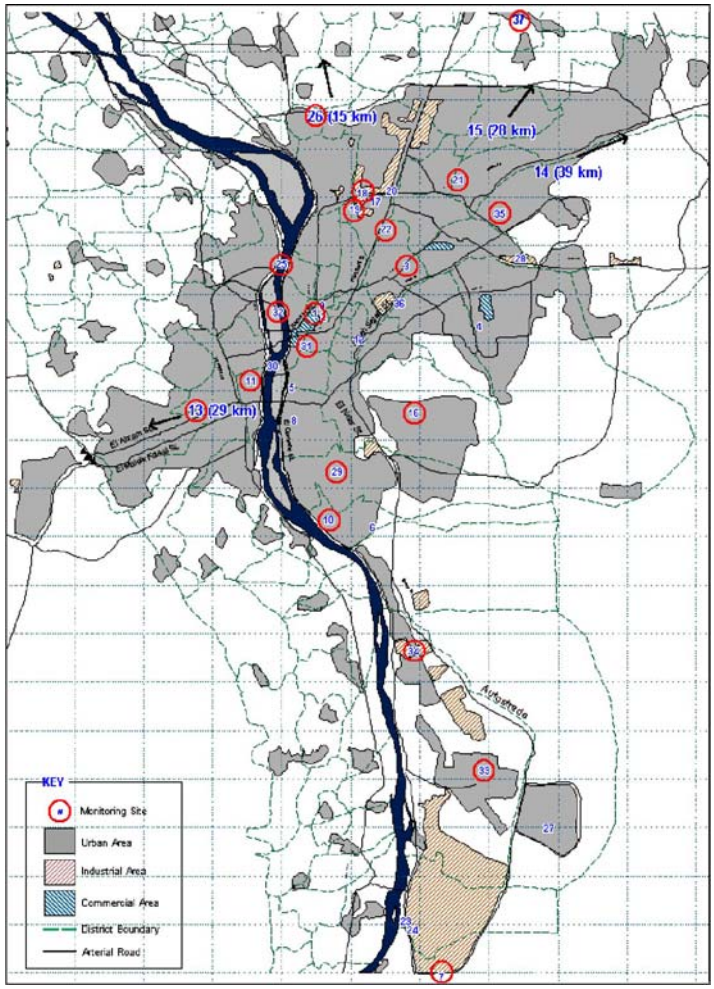
Measurement sites operated by the CAIP programme

The original CAIP programme was measuring PM_{10} /$PM_{2,5}$ in the greater Cairo area at 36 sites. This has been reduced to 20 sites. A map in Figure 1 indicate the positions of the following sites:

ID	Site	code	start	Type	Northing	Easting	PM2,5	PM10
1	ElQualalySquare	EQS	1June	Traffic	3326603	330594	X	X
3	KobryElKobba	MET	1June	Mixed	3328951	335190	X	X
7	TebbinSouth	TBS	17July	Industrial	3292317	336948	XC	XC
10	OldMaadi	EEA	1June	Residential	3315847	331076	X	X
11	Giza	AGL	10June	Traffic	3323063	327125	X	X
13	6thOctoberCity	OCT	1-nov	Residential	3313591	298716		X
16	Mokotam	ATI	1-nov	Residential	3321420	335413		X
18	ShobraKheima	MYC	1-nov	Residential	3332591	332797		X
19	ElSahel	TTI	1-nov	Industrial	3332027	332511	XC	XC
21	Matarya	DRC	1June	Mixed	3333406	337635	X	X
22	ElWaily	AMP	1-nov	Mixed	3330857	333996		X
25	Imbaba	HTI	1-nov	Residential	3329039	328829		X
26	Kaha	KFC	1June	Background	3350606	326517	X	X
29	Basateen	LRC	1June	Mixed	3318364	331495	X	X
31	TahrirSquare	AUC	1-nov	Mixed	3324855	329990	X	X
32	Zamalek	BIS	1-nov	Residential	3326590	328661	X	X
33	Helwan	HFS	1-nov	Residential	3302944	338983		X
34	ElMassara	SBH	1June	Mixed	3309097	335395	X	X
35	Heliopolis	OLS	1-nov	Residential	3331676	339733		X
37	AbuZabal	ABZ	1June	Industrial	3350930	342637		X

Sampling is undertaken using AirMetrics samplers every six day. The analyses have been undertaken at the Institute for Geological Surveys. Monthly reports are being prepared, but are delayed by about 5 months. The analyses take 2 months to finalise. This “problem” are being looked into and would be solved if analyses was to be undertaken at EEAA.

The CAIP programme also operates 4 meteorological stations (simple Met1 instruments). The meteorological stations are located at:
Kaha, Aby Zabal, Maadi and Tabbin South. Software supplied by these instrument do NOT allow hourly data for longer periods to be imported into a database



The Shoubra site together with Abu Zabal is considered very important Also Tabbin South is considered an important measurement area due to the high exposure of suspended dust to the population here. The Kaha site should according to the objectives represent a "background" area. However, there are so much activities, open air burning etc. in that area that the concentrations of PM_{10} is on the same level as in the city of Cairo.

TOP 5 PM10

Site_No	Site_Code	Easting	Northing	Average
37	Abu Zabal	342637	3350930	249,6
18	Shobra Kheima/MYC	332797	3332591	218,3
25	Imbaba	328829	3329039	215,5
22	El Waily	337635	3330857	213,8
1	El Qualaly Square	330594	3326603	203,2

Appendix E3: Proposed future AQ programme

Environmental Information
and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **25 October 2004**
To: **EEAA,** Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed (HAA)
From: **Bjarne Sivertsen (BS)**

Proposed future air quality monitoring programme for Egypt

Introduction

This memo is prepared to evaluate the cost of upgrading the present EIMP based air pollution network and establish a future sustainable integrated air quality monitoring and assessment programme for Egypt. The memo is based on the proposal presented in a report developed for EEAA on "A National Air Quality Monitoring Programme for EEAA, Egypt" (Sivertsen, 2004, NILU OR report, Draft October 2004)

Priorities for Egypt

A list of priorities will have to be prepared for keeping up an air quality network for EEAA that will meet the most urgent needs and at the same time meet the international requirements for quality and standard.

Such a list will include discussions on:

- Indicators (or compounds)
- Measurement methods
- Sites and areas to monitor
- Data retrieval system
- Data dissemination and data storage

The most important **indicators** for air pollution in Egypt, when related to international guidelines and standards are particulate matter (PM). The network of continuous on-line monitors as well as the manually operated AirMetrics network will have to be considered as one total system.

The second priority pollutants will be NO_2, ozone, SO_2 and CO (in that sequence). Other indicators such as BTX could be introduced in the future, while PAH and other organic compounds may be measured intermittently and not on a continuous

basis. Some of the points of view as well as conclusions are presented in the following.

Indicators and instruments

The most important air pollution indicator in Egypt has been proven to be suspended particles in air measured as PM_{10}. A basic network of monitors for PM_{10} measurements will have to be established for on-line transmission of data and information.

In addition to the on-line network of PM_{10} monitors, a number of sites should report PM_{10} and $PM_{2.5}$ based on the AirMetrics network established by CAIP and EIMP. These data are manually collected and analysed and reported after some weeks.

The second important indicators for characterising air quality in Egypt are probably ozone and NO_2. The available data have reported that the limit values have been exceeded several times in many areas.

SO_2 concentrations will have to be measured in all major industrial areas. In some of the industrial areas we have recorded that national and international limit values have been exceeded frequently. Also at least one site in central Cairo and Alexandria will have to report SO_2 originating from diesel-operated vehicles.

At a selected number of street and roadside stations also CO will have to be monitored. Exceeding of limit values has mainly been reported for the 8-hour average concentrations. VOC should be measured in areas where hydrocarbon emissions are expected based on a manually operated sampling programme. One on-line BTEX station could in addition be established in the city centre of Cairo.

Additional compounds influencing on the composition and nuisance of atmospheric pollutants have been discussed. In some areas, especially south of Alexandria, H_2S may be a major problem to the population. Ammonium chloride has been shown to be the third largest component of PM_{10} concentrations measured at Kaha, Zamalek and downwind from the Kaliobeya area. The reason may be the large emissions of ammonia from hundreds of chicken farms combined with the use of fertilisers in agricultural activities.

There is still also a need for analyses of lead near some of the industrial activities in Egypt. There will have to be a schedule and sampling programme prepared for this purpose based on the high volume PM_{10} filter samplers and some of the AirMetrics filters collected.

Sites and areas

The sites where air pollution will have to be measured and reported in the future have been discussed. We have preferred to divide the measurement sites into 3 classes of sites. A set of first priority sites has been selected to obtain on-line data as a basis for daily reporting of air quality. The sites should be the following:

- ElQuolaly, Cairo city centre highly impacted by traffic
- FumAlKhalig, Cairo, traffic and general urban
- Abbasseya, Cairo, urban background/ residential
- Gomhoreya Street, Cairo, street canyon site

- Kaha, upwind from prevailing winds at Cairo
- ElShouhada, central Alexandria traffic and general activities
- KafrZayat, most polluted industrial site in Delta

In the proposal for the future programme we have also included air quality monitoring sites in Heliopolis and one in the Governerate of Sharqiya between Bilbeis and Minyet ElQamh. The instruments to Heliopolis may be transferred from Assyut. There are also needs for new instruments to be purchased for these sites

Instruments presently operated at the Giza Campus site will be moved to a new site to be established at Giza Square. This site should measure NO_2, SO_2 and PM_{10}. Only ozone will be measured at Giza Campus to evaluate the regional formation of ozone in the greater Cairo area.

To keep up and operate an on-line air quality monitoring programme in Upper Egypt is very expensive and it is also labour demanding. It is therefore suggested that most of the measurement programme for Upper Egypt would be based on sampling systems, which will be collected and analysed in a central laboratory

However, on-line monitoring of SO_2 should be performed at the site in KomOmbo. This monitor will be taken from Aswan. In Aswan we will continue the on-line measurements of ozone.

Several changes, improvements and additions have been prepared and effectuated during the Phasing-out Phase of the EIMP programme as presented in the next chapter. New monitoring sites, improvements at existing sites as well as new procedures for field calibrations have been introduced.

New sites already decided

A new location was selected for monitoring in Suez in May 2003 (Sivertsen and Dreiem 2003a, Appendix B.8). Lack of permissions from the local police resulted in a change of position. The new site has been operated since the summer of 2004.

Danida had approved two new sites for installations in Beni Suef. Site inspections and site studies were undertaken on 21 October 2003. A proposal for installations including a rough cost estimate is presented in Mission report 03 (Sivertsen and Dreiem 2003b,Appendix B4).

Instrument lifetime and upgrading

The normal lifetime of air quality monitors that are being used in the EIMP programme is between 5 and 10 years. This implies that many of the monitors that have been installed since the end of 1997 till 1999 already are reaching the end of their normal lifetime.

To keep up the quality in the monitoring system, as well as assure sustainability we have proposed that old instruments are gradually replaced with new instruments. 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, and used for spare parts while a new instrument is being installed in field.

We will also propose to move gas monitors around in the system to assure that the most interesting and most impacted areas receive the attention needed. For the PM_{10} monitors, however, an urgent need for upgrading the instrument park has been demonstrated and reported in a memo presented to EEAA on 5 October 2004. The background is that the on-line continuous measurements of PM_{10} (as an indicator for suspended particles in air) are considered the first priority in the air-monitoring programme for Egypt.

There will also soon be a lack of gas monitors. Only about 33 out of a total of 53 monitors installed as a part of the EIMP programme were operating in October 2004, as seen from Table 1.

Table 1: Operating monitors in the EIMP programme as of October 2004.

Para meter	**Working monitor**	**N**	**Not working**	**N**	**Tot**
PM_{10}	Quo, Tab, Abb, Fum, Kah	5	IGSR, KaZ, Ass, Mah	4	9
NOx	Gom, Tab, Fum, CaU, Sho, Suez, KaZ	7	Quo, Mad, Kah, Ass, Man, IGSR?	6	13
SO_2	Quo, Gom, Abb, Tab, Mad, Fum, Suez?, IGSR, Sho, KaZ	10	Sho, CaU, Ass, Asw, Mans? Mah?	6	16
O_3	Abb, Asw, Ras, IGres	4	Kah, CaU?	2	6
CO	Gom, Fum, IGS	3			3
met	Ab, Tab, Asw, Mans?	4	Kah, IGres	2	6
	Total avail. monitors	**33**		**20**	**53**

There were several reasons for monitoring being out of operations; they were taken in for calibrations, for repair, they had missing spare parts, unknown errors in the instrument, and some instruments are already taken out of operations forever for the reason that crucial parts cannot be obtained from the instrument provider.

Most of the SO_2 and NOx monitors may be repaired. Spare parts such as coolers, PMT and peltier elements have to purchased. To get all the monitors back in operation has been estimated at about 200 000 EL.

Proposed future air quality measurement programme

Based on the discussion with EEAA experts and the teams at CEHM, IGSR as well as the personnel working with the PM sampling programme developed during CAIP, we have presented a first proposal for an updated measurement programme for air quality in Egypt. This proposal is presented in the following 3 Tables.

The highest priority stations for on-line transmission of data
A total of nine high priority stations will be operating on-line transferring data on a daily basis to the central computer at CEHM and at EEAA. These stations will have to get first priority in the future system. QA/QC as well as calibrations and instruments will have to be available at all times.

When considering the present status of the monitoring system as presented in Table 1 we will have to reorganise and move some of the monitors already located at different sites. A complete plan for this upgrading will have to be developed.

Table 2 presents the eight priority sites as well as the monitors and indicators included.

Table 2: First priority on-line monitoring system for Egypt.

ID	Station Name	Area Type	On-line data					
			Monitors					
			SO_2	NO_x	PM_{10}	O_3	CO	Met
Kol	El-Kolaly	Urban Center	1	1	1			
Gom	El-Gomhoryia	Street Canyon	1	1			1	
Abb	Abbassyia	Urb. /Res.	1		1	1		1
FKa	Fum El-Khalig	Roadside/Urb.	1	1	1		1	
GiS	Giza square	Urb/road	1	1	1			
Kah	Kaha	Regional back		1	1	1		1
Sh	El Shouhada	Traffic	1	1	1		1	
KZa	Kafr El-Zayat	Industrial/Res.	1	1	1			1
Hel	Heliopolis	Urban	1	1	1			

At Quolaly we also propose to measure BTEX continuously. We see that there is a need for 8 PM_{10} monitors only in this part of the monitoring programme. Presently there are only 5 such instruments operating in Egypt as seen from Table 1.

In the future it may be possible to establish an automatic data retrieval system collecting the data every hour into a central database. The AirQUIS database has been tested at EEAA, and discussions have proven that automatic transfer is possible and may be developed.

Second priority network
A second set of air quality measurement stations will combine monitors and samplers. Among these stations are also four selected sites for ground level ozone measurements; Ras Mohamed, Aswan, Alexandria IGSR Regional and the Cairo University campus area (at Giza). Together with the two priority sites Kaha and Abbasseya included above, the ozone programme will represent different purposes, and may give a good picture of the background ozone level in Egypt as well as regionally formed ozone.

There is also a new site proposed in the Governerate of Sharqiya to monitor the plumes generated from burning of agricultural waste in eastern Delta. The site proposed is located between Bilbeis and Minyet ElQamh, in the small village of Nishwa.

The new sites, which are now being established in Beni Suef are combined monitoring and sampling sites, which are also included in the total programme for EEAA

There will thus be a total of 24 sites equipped with monitors of some kind. Whenever monitors break down totally, the first priority programme will have to be secured. Monitors from sites such as ElMahalla and ElMaadi may be used in a case of lack of monitors in the first priority programme.

There will thus be a total of 13 PM_{10} monitoring sites, which all should be given high priority. However, again in cases of instrument break down it would be advisable to have priority in the first group of sites. We have also indicated in a memo dated 5 October 2004 the need for purchasing more PM monitors. The cost for this upgrading has also been presented.

Table 3: Air quality measurement sites with combined monitoring and sampling.

ID	Station	Area	Instrumentation								
	Name	Type	Monitors				Samplers				Other
			SO_2	NO_2	PM_{10}	O3	BS	NO	PM	TSP	
Mad	El-Maadi	Resid	1	1					AM		
Tab	Tabbin	Industrial	1	1	1						Met
Sho	Shoubra	Industrial	1					SS	AM	S	Metmin
Suz	Suez	Urban	1	1					AM	S	DF
Kom	KomOmbo	Industrial	1				1		M		DF
IGS	IGSR	Urb/Road		1					AM		PS
IGR	IGSR Reg	Backgr.				1					Met
GiC	Giza Camps	Resident				1			AM		
BSG	B Suef, Gov	Urb bckg	1	1	1	1					Met
BSC	B Suef ,prk	Urb/road	1	1	1						CO
Asw	Aswan	Urb./Res.				1			AM		DF, PS
RaM	Ras Moham	Backgr				1			AM		PS
Mah	ElMahalla	Indus/res	1		1				AM		
Man	ElMansura	Indus/res	1	1					AM		
Nis	Nishwa	Backgr	1		1						

Sampling sites

The last part of the total air quality measurement programme for EEAA and Egypt consists of 32 sampling sites of various composition and importance. The main core of this programme is based on sequential samplers for SO_2, NO_2 and soot (black smoke, BS) and AirMetrics type PM_{10} and $PM_{2,5}$ samplers. The most important part of these measurements will be to present a complete picture of the PM exposure in Egypt

Additional passive sampling has been included in this programme to measure time-integrated concentrations of SO_2 and NO_2. In the proposal presented in Table 4 we have also included 10 sites presently covered by the CAIP installed sampling programme.

The meteorological stations have been located at sites where monitors and shelters are already available. The sites have been chosen to give a general wind pattern for the greater Cairo area as well as for Alexandria and the Delta. Important information missing in the existing programme is a stability parameter. This will have to be secured in the future network.

Table 4: Air quality sampling sites covering urban, residential and industrial areas with a possibility for air pollution impact in Egypt.

ID	Station Name	Area							
		Type	Samplers						Other
			SO_2	BS	NO_2	PM_{10}	TSP	DF	
NAC	Nasr City	Residential	SS	SS	SS	S			$PM_{2,5}$
TaS	Tabbin South	Industrial	SS	SS		AM	S	NC	VOC
AZa	Abu Zabel	Ind./Res.				AM		NC	PS
6oc	6 October	Res./Ind.	SS	SS	SS	AM			
10R	10 Ramadan	Residential	SS	SS		AM			
PSa	Port Said	Residential				AM			PS
Ism	Ismailia	Urb. /Res.				AM			PS
Fay	El Fayum	Urban				AM		NC	PS
BSN	BeniSuef,New	Resident				AM			PS
Min	El-Minya	Res./Ind.				AM		NC	PS
Ass	Assyut	Res./Urb.				AM		NC	PS
NgH	Nag Hammad	Ind./Res.				AM		NC	PS
Lux	Luxor	Urb./Res.	SS	SS		AM		NC	
Edf	Edfu	Ind./Res.				AM		NC	PS
ElT	ElTahr	Industrial				AM			PS
Max	El-Max	Industrial	SS	SS	SS	S		NC	VOC
Awd	El Awaid	Residential	SS	SS		S		NC	PS
GEl	Gheat El-Inab	Residential	SS	SS	SS	S			
Dam	Damanhur	Industr/Res				AM			PS
Tan	Tanta	Urban	SS	SS		S			PS
Dam	Damiatta	Residential	SS	SS		S			PS,VOC
KDw	Kafr El Dawar	Residential	SS	SS		AM			PS
Mok	Mokatam hill	Residential				AM			
Sah	ElSahel	Industrial				AM			
Mat	Matarya	Mixed				AM			$PM_{2,5}$
Wai	ElWaily	Mixed/Ind.				AM			
Emb	Embaba	Residential				AM			
Bas	Basateen	Ind/res				AM			$PM_{2,5}$
Thr	Tahrir Square	urban				AM			$PM_{2,5}$
Zam	Zamalek	Residentia				AM			$PM_{2,5}$
Hwn	Helwan	Residential				AM	S		DF
Mas	El Massara	Ind/res				AM			

SS = Sequential sampler S = sampler (high vol) NC = NILU dust fall collector
AM = AirMetrics PM sampler PS = Passive sampler Met = Weather station
VOC= Volatile organic compounds sampler

Realising that suspended particulate matter is the main air pollution problem in Egypt it will be important to collect all data in the same database. This will give a better and total picture of the air pollution situation of Egypt.

There will according to the proposal presented here be more than 50 sites in Egypt covering the particulate matter problem. It will also be required to select a number of filters each month for the analyses of elements such as lead (Pb) and cadmium (Cd).

The measurement programme as it has been proposed for Cairo is presented in Figure 1. In the area presented by the map in Figure 1 a total of 23 stations will be operated. From these there will be 6 on-line monitoring sites (first priority). Five

sites will have monitors and samplers from which the monitor data will be transmitted on-line. Another 12 sites will have only samplers.

Figure 1: Different types of monitoring and sampling stations proposed for the Cairo area.

Cost estimate

The cost estimate below has been based on a careful upgrading of the existing EIMP programme. We have concentrated the efforts on achieving a well-operated on-line monitoring system.

There are a number of high volume samplers in the programme to day, which are not working due to missing spare parts. Most of this problem may be solved in the near future. PM_{10} sampling will also be undertaken using AirMetrics instruments. We assume that there will be a sufficient number of these instruments already at EEAA as part of the former CAIP developed sampling programme.

The monitoring programme

An overview of monitors available and missing in a future monitoring programme is presented in the following table.

ID	Site Name	Area Type	On-line data					
			Monitors					
			SO_2	NO_x	PM_{10}	O_3	CO	Met
Kol	El-Kolaly	Urban Center	a	a	a			
Gom	El-Gomhoryia	Street Canyon	a	a			a	
Abb	Abbassyia	Urb. /Res.	a		a	a		a
FKa	Fum El-Khalig	Roadside/Urb.	a	a	a?		a	
Kah	Kaha	Regional back		a	n	n		a?
Sh	El Shouhada	Traffic	a	a	n		m?	
KZa	Kafr El-Zayat	Industrial/Res.	a	a	n			m
Hel	Heliopolis	Urban	m	n	n			
Mad	El-Maadi	Resid	a	a				
GiS	Giza square	Urb/road	a	n	n			
Tab	Tabbin	Industrial	a	a	a			a
Sho	Shoubra	Industrial	a					a
Suz	Suez	Urban	a	a				
BSG	B Suef, Gov	Urb bckg	a	a	a	a		a
BSC	B Suef ,prk	Urb/road	a	a	a		a	
Kom	KomOmbo	Industrial	m					
IGS	IGSR	Urb/Road		a				
IGR	IGSR Reg	Backgr.				a		n
GiC	Giza Camps	Resident				a?		a
Asw	Aswan	Urb./Res.				a		a
RaM	Ras Moham	Backgr				a		
Mah	ElMahalla	Indus/res	a		?			
Man	ElMansura	Indus/res	a	a				
Nis	Nishwa	Backgr	n		n			
Number of instruments available			18	13	5	5	3	7
Number of instruments needed			**1**	**2**	**8**	**2**	**1**	**2**
Total number of monitors in system			14	15	13	7	4	9

a = available at site , n = not available, m = to be moved from other site
? = Inadequately operating

As can be seen from the table a total of 8 PM_{10} monitors and 6 gas monitors as well as 2 meteorological stations will have to be purchased to update the national air quality monitoring programme for EEAA, Egypt. In addition we will have to procure one BTEX monitor.

There will according to the proposal presented from the EIMP programme (Sivertsen 2004) be more than 50 sites in Egypt covering the particulate matter problem. Some of the old high volume samplers will have to be repaired and a constant need for spare parts have to be identified and purchased. It will also be required to select a number of filters each month for the analyses of elements such

as lead (Pb) and cadmium (Cd). This, however, may be some of the future operational costs, which is not included here.

To operate the system in a more flexible and real-time way the on-line data retrieval system will have to be optimised and a new database and assessment system will have to be installed at EEAA.

Ambient monitors and various equipment	Estimated price (1000 EL)	Number instruments	Total 1000 EL
SO_2 Pulsed UV fluorescence	90	1	**90**
NO/NO_x Chemiluminescence	95	2	**190**
CO Gas filter correlation/infrared abs.	95	1	**95**
BTEX	180	1	**180**
Ozone UV photometry	70	2	**140**
Air Intake	30	4	**120**
Spare parts to set air monitors in operation	20	12	**240**
PM 10 monitor (ESM Andesen)	147	8	**1176**
Automatic Weather station (AWS)	85	2	**170**
Met. Mast	55	2	**110**
Dataloggers	40	3	**120**
Shelter	20	3	**60**
Rack+aircon+power+telephone	15	3	**45**
Moving and installations	5	3	**15**
Total for new monitors and 3 sites needed			**2751**

A number of calibration gases are also needed.

The database, air quality assessment and planning tool
Updating the air pollution database has been offered previously to EEAA at a special price of **130 000 EL**.

This Air Quality Measurement Module, which is a minimum required for operating the air quality measurement programme includes the basic Kernel and the GIS system, the measurement module, additional software, statistical programmes, graphical presentation tools, hardware, computers (server), installations and some basic training.

The total AirQUIS package will enable EEAA to start collecting input data for modelling and air quality assessment and planning. This will require emission inventories and dispersion models, which will be part of the deliveries. The estimated total cost of for the necessary tools to enable EEAA to start air quality management and planning has been presented in previous plans and proposals and amounts to a total of **400 000 EL.**

This will include installation training and the following modules:

- Geographical Information System (GIS)
- Measurement database based on Oracle
- Statistical and Graphical Presentation Tools
- Emission Inventory modules and templates
- Atmospheric Dispersion models
- The exposure and planning tools
- Graphics and web based data dissemination systems.

The total cost for upgrading the EEAA national air quality monitoring system will thus be about **3.1 million Egyptian Pounds.**

Appendix E4: Data structure

Environmental Information
and Monitoring Programme
Phasing out Phase
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Memo

Date: **28 September 2004**
To: The Nguyen Thanh, NILU
Copy: Haytham, Hossam
From: **Bjarne Sivertsen (BS)**

System Manager Data Structure

As part of the preparation of the databases for AirQUIS to be installed at EEAA we have tried to identify the structure of these data.

Hossam ElShakhs, who is responsible for the database at EEAA has given the following statement, which had been mailed to NILU by Haytham:

The system manager data is all collected in a single table (hravedata) the other tables is considered a reference tables. (hravedata means one-hour average data).

The structure of this table is as follow:

```
CREATE TABLE dbo.HRAVEDATA (
Parameter varchar (5) NULL ,
Date datetime NULL ,
HrAveData real NULL ,
HrFlag varchar (1) NULL
)
GO
```

So we suppose that the AirQUIS support an interface for importing the data from the system manger database (sqlserver) to the AirQUIS database.

For any further information please contact me.

Hossam El-shakhs
Software developer
G9_master@yahoo.com

Appendix E5: AirQUIS integration

Memo

Title	**How to integrate AirQUIS into the existing database system and dataflow at EEAA**
Participants	Mr. Haytham Ahmed, Mr. Hossam and Mr. The Nguyen Thanh
Distribution	Mr. Bjarne Sivertsen and the EEAATeam
Author	TNT
Date	26 October 2004
Reference No	P814

Short description of the existing solution
EEAA are using EMC system for retrieval of air quality and meteorological data. A local system called AQMon has been developed since 1998 by Danish consultants and now being further developed by EEAA for EEAA needs. The system is mainly designed for transfer and preparation of data from EMC database and for reporting purposes.

Cairo University is responsible for collecting and quality assure data. Cairo University use the EMC System Manager to do quality assurance of the data. At the end of each month Cairo University send an export file with quality assured data to EEAA. EEAA produce monthly reports based on the exported file. The quality assured data is stored in database called LIVECAIRO.

EEAA needs also daily reports. To be able to produce daily report EEAA collect data directly from EMC Station Manager for production of daily reports. EEAA stores this data into LIVEEEAA.

EEAA has also experienced very slow response time with large amount of data.

Short overview of EEAA measurement network:

- 17 automatic stations
- EMC for data retrieval using modem
- EEAA retrieve raw data, once a day, from the stations
- MS SQL is the database platform
- Weekly cold backup of the database
- CD-ROM (700 MB) is used as backup storage
- EMC is connected to a TCP-IP network at EEAA

How to integrate AirQUIS into the existing solution
AirQUIS is designed especially to handle huge amount of data for e.g. model calculations.

What can be done to provide EEAA with a state-of-the-art solution for handling measurement data, perform QA/QC, statistics and reports?

Data transfer to AirQUIS:
NILU can develop an automatic scheduled routine for transferring data directly from LIVEEEAA to AirQUIS daily project/database called LIVEEEAA by

integrating the existing data extraction routine developed by EEAA for daily report.

NILU can develop an automatic scheduled routine for transferring data directly from LIVECAIRO to AirQUIS daily project/database called LIVECAIRO by integrating the existing data extraction routine developed by EEAA for monthly report.

QA/QC:
AirQUIS can be configured to perform automatic QC during data transfer from LIVEEEAA and LIVECAIRO.

EEAA personnel when needed can perform final quality controlled in AirQUIS.

Statistics:
AirQUIS provides a set of standard statistics needed for the end user.

Reports:
NILU can develop a set of standard report e.g. daily, monthly, quarterly and yearly based on EEAA specifications. These reports can be scheduled to run automatically.

Activities done
NILU has imported 3 months of data from 17 automatic measurement stations into AirQUIS based on input from Mr. Haytham.

A short demonstration of AirQUIS measurement has been given the EEAA team.

NILU has also lent EEAA a laptop with AirQUIS for testing purpose.

Activities to come
Phase I:
EEAA can import data by Excel sheets with the format specified in AirQUIS documentation. NILU can assist EEAA if needed.
Phase II:
Direct transfer from MS SQL to Oracle database in **AirQUIS** if EEAA choose AirQUIS. Development of the automatic reports will also be a part of this phase.

Appendix F

Administrative work

Appendix F1: Air follow-up

Environmental Information and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **22 September 2004**
To: Danida
From: **Ahmed Abou Elseoud (AAE), B Sivertsen**

Proposal for allocating funds for follow-up of the Air Quality monitoring programme for Egypt

The air quality monitoring programme developed as part of the EIMP programme has become a comprehensive system operated by a team of about 25 experts. More than 40 different sites covering all Egypt are measuring a number of air pollutants. The system has to be maintained and serviced every day and every week, and adequate understanding of the air quality issue as well as quality assurance has to be at hand in the staff. Also equipment such as consumables and spare parts has to be made available.

In a memo dated 16 March 2004 (See Mission report 04 from Air Quality Monitoring Component, page 67) we estimated the total cost of operating the programme at about 2,2 million Egyptian pounds, including upgrading of equipment. Most of the instruments are more than 6 years old, and the normal lifetime of these kind of instruments are between 5 and 10 years.

Another important factor ensuring sustainability in the programme is to verify that the operators as well as the EEAA experts understand quality assurance, and is able to interpret the information that emerges from the data. This has been some of the main issues during the last Missions of the Phasing-out-Phase related to the Air Pollution Monitoring Component of the EIMP project. We still have a feeling that the training and development of new ways of storing, presenting, assessing and using the data is further needed.

The expatriate instrument expert is also performing station audits and instrument repairs that have saved the project a considerable amount of money. We suggest that a follow up of all these activities will be undertaken if funds are still available in the project.

To ensure that the results and conclusions as well as tasks given during the last mission by the expatriate air pollution experts are well handled and taken into account by both the Monitoring Laboratories as well as the EEAA staff, we suggest that this follow-up will be undertaken early in 2005.

The Terms of Reference for this additional Mission including the tasks and needed actions presented in the Appendix.

A budget estimate indicates the following costs:

Specification	Unit price (DKK)	N	Ident	Total cost (DKK)
Air tickets t/r	4500	2	travels	9000.00
Accommodation	750	35	days	26250.00
Subsistence	305	35	days	10675.00
Local transport	taxi, train etc		estimate	600.00
Fee (B Sivertsen)	820	120	hours	98400.00
Fee (R Dreiem)	650	80	hours	52000.00
Total budget				**196925.00**

The total estimated budget for this follow-up programme is 196,925.- DKK.

Attachment Appendix F1

The Terms of Reference for a follow-up Mission of the EIMP programme, Air pollution Monitoring

The development objective of the Air Component of the EIMP programme has been to establish detailed knowledge of the ambient air quality in Egypt for the relevant authorities to act to improve the air pollution situation in Egypt. This has been achieved through the establishment of a high quality environmental monitoring programme. The Monitoring Institutions (at CEHM, Cairo University) and at IGSR (Alexandria University) together with a trained team of experts at EEAA should be able to produce data series, which will constitute the basis for appropriate political actions to be taken.

The immediate objectives of the EIMP programme was:

- To commission and operate equipment (including trained relevant staff) for data collection on ambient air quality including a reference laboratory, as well as the EEAA data management.
- To train the Monitoring institutions to be capable of producing validated (in accordance with international standards) and consistent data on conditions of the ambient environment.
- To enable the staff at the Monitoring institutions as well as the EEAA staff to understand, interpret and assess their respective analytical data.
- To establish a Reference laboratory capable of providing QA/QC services to monitoring institutions to meet the requirements as specified in international standards and guides.

The two-years Phasing-out Phase has been concerned with establishing routine operation and routine laboratory procedures and gradually improving the quality of the monitoring data. A number of mistakes and errors have been corrected.

Some of the specified tasks to be undertaken during the Phasing out Phase were:

- Full-scale monitoring programme (40 stations) in operation
- Monitoring institutions producing completely validated data
- Uninterrupted transfer of data to EEAA
- Data input for "State of the Environment" reports prepared by EEAA
- Plans, standards and procedures adjusted as and when required
- Air quality monitoring network assessment to prepare a comprehensive plan for a future National Air Quality Monitoring Network (combining existing (EIMP and CAIP) networks and identifying future needs)
- Finalisation of procedures at the Reference Laboratory, (relation to accreditation)
- Dissemination of monitoring data

- Integration of EIMP programme activities into the existing EEAA organisational structure (TA support only upon request from EEAA)

Work has been undertaken on all these tasks. However, it is felt that there are still some missing components and training needed before the air pollution programme is completed. The full-scale monitoring programme is working. After 7 years of operation (the complete programme for 5 years) it has to be stated that the operation and quality of the air quality monitoring system is actually better than anticipated 7 years ago.

Instruments
However, several instruments are still at repair or are missing crucial parts, which have even not been ordered. Some of them are even out of stock at the instrument providers. NILU is presently trying to make one of the important PM_{10} monitors part. The routine follow-up of consumables and spare parts has to be upgraded.

Data transmission and databases
The data transmission and databases are working, but errors and problems seem to occur too often to consider the situation satisfactory. We are not sure whether the EEAA database will sustain for more years to come and for additional stations to be implemented.

A proposal for one integrated national network for air pollution measurements will be prepared and presented after Mission 05, ending on 28 October 2004. To complete the existing network and integrate new monitoring stations, such as from Beni Suef as well as data collected by the network established under the CAIP programme, we feel that a new and modern database should have been available at EEAA.

Understanding air pollution

The weakest points in the list given above will still be the understanding of air quality by the EEAA staff, enabling them to create a “State of Environment” report. Air quality assessment and preparing data for air pollution actions is still not completed.

Data dissemination

We have a feeling that data dissemination and information to the authorities as well as to the public is not sufficiently established. The data dissemination programme could be improved by establishing a simple “AirOnline” web page, which is updated automatically every day. During the last mission we designed a daily report for air quality in Cairo, but this has to be produced manually every morning. We have indicated that an AirOnline system is available and can be installed at EEAA without too high costs.

Future planning tools

The data available in the programme can be used for investigating the impact and results on the air quality of any random action taken (trend analyses). However, to plan actions in the most cost effective manner air pollution dispersion models and

exposure models are needed at EEAA. We have several times proposed that the monitoring programme, which was developed by the Danida funded EIMP programme should have a follow-up including air quality planning tools. These efforts will have to be designed in a new future programme for EEAA.

During the follow-up programme proposed in this Phase of EIMP we will suggest the following actions to be taken:

9. Check instruments; repair whatever errors are still prevailing
10. Based on a prioritised programme covering Cairo as well as most efforts on on-line PM_{10} monitoring change and upgrade the programme to meet these needs
11. Verify that the QA/QC procedures at the Monitoring institutions as well as at the Reference laboratory are now fully understood and followed up
12. Perform training again to assure that the experts at all institutions including EEAA understand and can interpret the data
13. Prepare more newsletters (on paper in colours) to be widely distributed
14. Discuss other ways of data dissemination and spread of air quality information
15. Integrate all air quality data into one database and one programme for EEAA
16. Modify and improve the annual report to include trends, assessment and more discussions on potential source impacts

The follow-up mission will include a 3 week visit by the expatriate air pollution expert and two weeks visit by the instrument expert.

Appendix F2: Comments

Environmental Information
and Monitoring Programme
Phasing out Phase
EEAA - Danida - COWI
30 Misr-Helwan Str. Maadi, Cairo, Egypt
Tel: 202 525 6442, Fax: 202 525 6467

Memo

Date: **27 October 2004**
To: Ahmed Abou Elseoud (AAE),
Copy: Haytham Ahmed (HAA), Ashraf Saleh Ibrahim(ASI)
From: **Bjarne Sivertsen (BS)**

Comments at the end of Mission 05

The EIMP Phase-out Phase has come to an end and several comments, advices and tasks could have been summarised at the last meeting. However, we will mainly refer to the Mission reports, and especially the end of Mission 05 report, where comments and status at all levels of the EIMP programme has been presented.

The expatriate air quality experts from NILU are **pleased to note that**:

- The spare parts, which have been "stuck" in storage at EEAA to a large degree has been transferred to CEHM, where they are mostly needed.
- Some of the new sites such as Suez and Beni Suef is being installed and will operate in the near future
- Discussions of the future air quality programme for Egypt has lead to a proposal, which seem to have raised both interest and enthusiasm.

We are **concerned about**:

- The daily and weekly QA/QC and data follow-up at the Monitoring institutions as well as at EEAA.
- "Calibrations" and verifications performed at the Reference Laboratory, NIS does not seem to be followed up adequately from EEAA. Mistakes and misunderstanding concerning calibration procedures has been revealed.
- The communication and co-operation between the three levels of the total monitoring programme. To achieve good results and good quality data requires a positive atmosphere and communication; CO-OPERATION.

We would **suggest that**:

- The responsibility for ordering and keeping an adequate storage of reference and calibration gases are placed at ONE institution. We further recommend that the responsibility as well as the costs for theses tasks is part of the contract for Reference Laboratory – Air.

- EEAA should order a sufficient amount of regulators for the calibration gas cylinders, to avoid loss of gas and potential errors introduced in the calibration by moving regulators from bottle to bottle. (See Mission report 04)
- The quality assurance managers at both Monitoring Institutions should spend more time and efforts to follow up QA/QC routines. They should be requested to document their inspections with signatures on the logs, and report to EEAA each quarter with the Quarterly reports.
- Shelters that need repair should be identified as soon as possible, and EEAA prepare a cost estimate and arrange for routines and payment to the Monitoring institution, who perform the work.

Some tasks that need to be undertaken and REPORTED:

- Field studies using sequential samplers, passive samplers and an EMEP sampler has been designed. The field tests have to be undertaken as soon as possible and reported!
- Some of the changes in the monitoring programme as suggested for the future programme can be started soon without any additional funding; Prepare moving shelter and instruments from AlAsafra to new site at Municipal Waste at ElAwaid and move AbuQuir to ElTarh.
- Perform site studies , site visits and present site report for Heliopolis, Giza Square and Governerate of Sharqiya (Nishva).
- Stop monitoring at Assyut 1, and establish site in Heliopolis. Repair instruments from Assyut and use them at Heliopolis.
- Move SO_2 monitor to KomOmbo, establish telephone line.
- VOC sampling programme has to be followed up. Continue sampling at ElShouhada, ElMax, Damietta and ElGomhoreya Street.
- Approve lead (Pb) sampling programme from CEHM, presented by Dr. Tarek.
- Follow up the installations of measurements in Beni Suef. Discuss possible changes in the programme, including new site studies during next Mission. (AAE, BS)
- Follow up meteorological sensor upgrading! New sensors are needed for IGSR as soon as possible.

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ABSTRACT

The EIMP Phasing-out Phase has been formulated to consolidate EIMP achievements, while gradually integrating the EIMP activities and staff into the existing EEAA administrative and organisational structure. The fifth Mission during the EIMP Phasing out Phase Air Quality component was undertaken during 18 September to 28 October 2004. Bjarne Sivertsen and Rolf Dreiem participated in the Mission. Continued training in reporting and air quality assessment was important parts of the Mission. New sites were visited to update and improve the national monitoring programme.

Site visits were also undertaken to check the quality of measurements, maintenance and repair. Several meetings were held during the Mission, and various type of support was given to EEAA to upgrade and improve the air quality monitoring network. Separate report designing a national air quality monitoring system for Egypt was prepared, discussed and presented during Mission 05.

NORWEGIAN TITLE

Overvåkingsprogram for luftkvalitet i Egypt

KEYWORDS		
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ABSTRACT (in Norwegian)

** Classification*

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