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Projet:	ASSISTANCE TECHNIQUE A LA MISE EN PLACE DU LABORATOIRE CENTRAL ET DES STATIONS DE MESURES POUR L'AMELIORATION DE LA QUALITE DE L'AIR EN MILIEU URBAIN DE DAKAR
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Technical specification for establishing the Monitoring Network and Calibration Laboratory in Dakar

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Summary

Financed by the Nordic development Fund (NDF), the Norwegian Institute for Air Research (NILU) is supporting the Conseil Exécutif des Transports Urbains de Dakar (CETUD) in establishing a Central Laboratory with an Air Quality Management System for Dakar. This project is part of the component entitled as “Amélioration de la qualité de l’air en milieu urbain” (QADAK) of the “Programme d’Amélioration de la Mobilité Urbaine” (PAMU) operated by the Conseil Exécutif des Transports Urbains de Dakar (CETUD).

This report contains all relevant physical technical specifications for the Monitoring Network and Calibration laboratory for air quality and meteorological measurements. The report also includes commissioning, testing and training requirements.

The air quality and meteorological network for Dakar will be operated on central level by the Centre de Gestion de la Qualité de l’Air (CGQA) with one central database for all ambient measurements. The measurements will be transferred directly to a central database for data storage, quality control, evaluation and presentation. Technical specifications of the monitors, gas cylinders, shelters, and computers are given for use in tender documents.

This report covers several reports, defined as the following deliverables in Partie 8 of the Contract:

- **4.c** Cahier des charges techniques des équipements à acquérir ;
- **4.d** Dossiers d’appel d’offres pour le réseau de mesure;
- **8.d** Spécifications techniques de l’instrumentation pour le laboratoire de calibrage;
- **8.e** Dossier d’appel d’offres pour le laboratoire de calibrage.

This report is also available in French (NILU OR 77/2006).



Air quality in urban environment of Dakar



Technical specification for establishing the Monitoring Network and Calibration Laboratory in Dakar

1 Introduction

1.1 Monitoring network

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

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** is needed. 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.

The Air Quality and Meteorological Network will be co-ordinated on central level with one central database for all ambient measurements at CGQA. The measurements will be transferred directly to a central database for data storage and quality control.

The fixed ambient monitoring programme will be using in-situ measurement instrument located at permanent measurement stations.

The monitoring network for Dakar will have 5 permanent automatic air quality stations, one meteorological station and three additional sampling stations for PM₁₀ and/or PM_{2.5}. The following instruments are assigned to the permanent automatic air quality monitoring:

- 5 NO_x monitors,
- 5 PM₁₀ monitors,
- 2 PM_{2.5} monitors,
- 3 SO₂ monitors

- 2 CO monitors
- 3 Ozone monitors
- 1 BTEX monitor

In addition there will be one automatic weather station, 3 manually operated MiniVol Samplers and one sequential PM sampler. The monitoring programme is presented in Table 1 and in **Error! Reference source not found.**

Table 1: The continuous air quality monitoring programme for Dakar, considering the first alternative for the location of each permanent station.

Site	Station name	Type *	NO2	SO2	CO	PM ₁₀	PM _{2,5}	O3	BTEX	Meteo tower
1	Boul. Rep	UT	X	X	X	X	X	X		
2	Medina	ST	X		X	X				
3	HLM4	UB	X	X		X		X		X
4	BelAir	UI	X	X		X	X		X	
5	Yof	RB	X			X		X		

*U – Urban T – Transport
 S – Suburban B – Background
 R – Regional I – Industrial

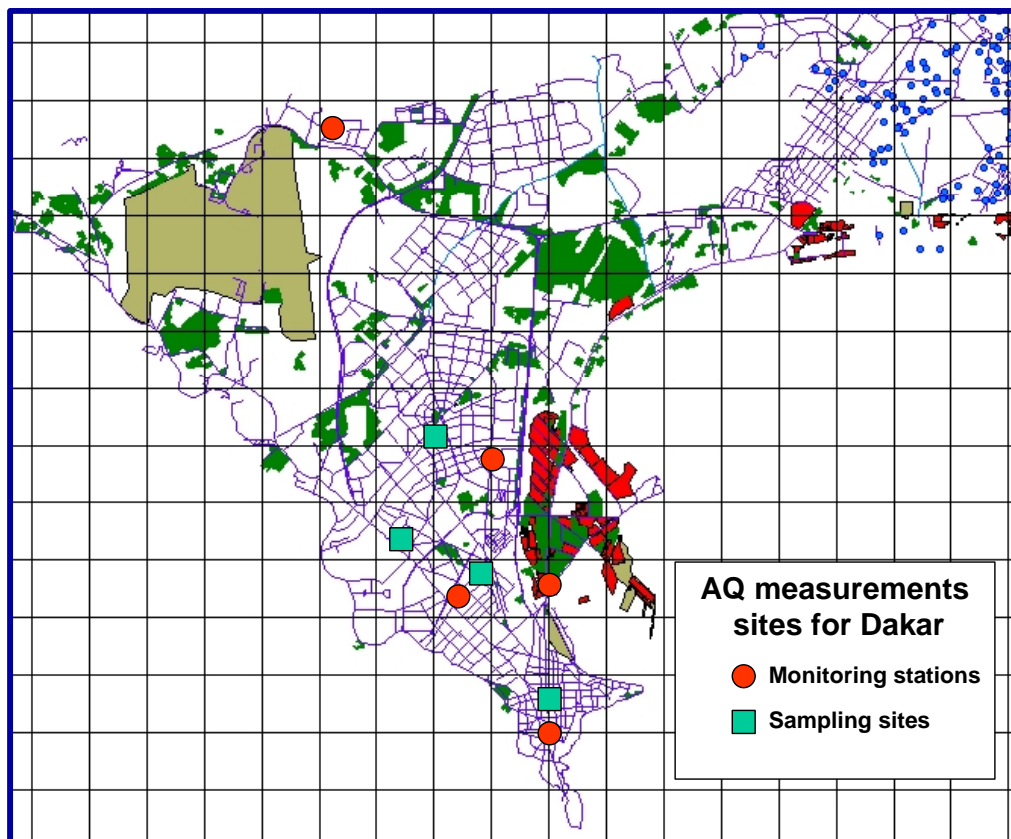


Figure 1: A summary of measurement sites selected for the air quality monitoring programme in Dakar.

A summary of the locations of monitors and samplers selected for the Dakar air quality monitoring programme is presented on the map in Figure 12.

More information is given in the report “Programme de contrôle de la Qualité de l’Air à Dakar, Résultat de l’étude de conception ” (Bjarne, 2006).

1.1.1 Meteorological station

The meteorological station should describe both spatial variations and the vertical structure of the atmosphere for dispersion modeling purposes. This tower will be located next to an AQ station.

Table 2: Characterisation of meteorological stations.

Type of met. station	Parameters
10 m tower for weather description	Wind speed and direction, temperature, vertical temperature difference, turbulence, relative humidity, atmospheric pressure, precipitation and net radiation

1.2 Calibration Laboratory

An overall objective of the Calibration Laboratory is to assure equal quality of the data from the different monitoring stations in Dakar and to assure that the same data is comparable to each other.

To fulfil the overall objectives, the Calibration Laboratory will be responsible for the development, administration and maintenance of the Quality Assurance and Quality Control system (QA/QC system) for the operations of the Air Monitoring Network in Dakar. This includes preparing new standard operation procedures (SOPs), updating the quality documentation, informing the network operator on changes and updates in the QA/QC system, etc.

The Calibration laboratory will maintain the reference calibration standards. The reference standards will represent the highest level of calibration in the traceability chain designed for the measurement network. The Calibration laboratory will provide traceability to the monitoring network by calibration of their working standards as well as calibration of their instruments. The Calibration Laboratory will perform audits to the measurement network to assess the actual quality of the measurements.

2 General requirements

The following general requirements apply to all equipment specified in this procurement document.



2.1 Instructions

The supplier shall provide a user and technical manual and concise and clearly written documentation in French language, which provides the following data:

- a) Clearly written instructions for routine use and maintenance.
- b) Clearly written instructions for troubleshooting and repairs
- c) Description of preventive maintenance and preventive maintenance schedules
- d) A specification of equipment performance characteristics and productivity.
- e) Full health and safety information.

Accessory, consumables and spare parts

The delivery shall include a list of accessory, consumables and spare parts kit for 3 years' operation, according to supplier's experience. Budget for accessories, consumables and spare parts must be clearly specified.

The supplier must have spare parts in stock for at least five years after delivery of the instrumentation.

Packing and delivery

Delivery of equipment to CETUD, Dakar, including insurance, packing and transportation should be provided by the supplier.

The delivery shall take place less than two months after acceptance of the contract. If otherwise, the time of delivery shall be specified by the supplier.

The bidder is responsible for a packaging that ensures against damage during transportation to Dakar.

Installation

The instruments shall contain instructions in French and in English that enable installation and start of operation by a person with a degree in science.

After sales facilities/incidental services

Name and location of nearest organization for incidental services shall be specified.

Warranty

Warranty of a minimum of 1 year for overall equipment is required. The warranty period shall be specified.

The bidder is advised to visit the sites prior to submission of tender, in order to estimate civil work costs with construction and installations.



3 Technical specifications of the equipment

3.1 Equipment and software specifications for AQ stations

The air quality monitoring stations shall consist of a shelter with air condition, telecommunication, monitors, data acquisition system, in addition to a meteorological tower. The stations shall have direct communication to the central system for online control and data transfer.



3.1.1 Shelter for fixed AQ stations

Quantity of equipment: 5

Purpose

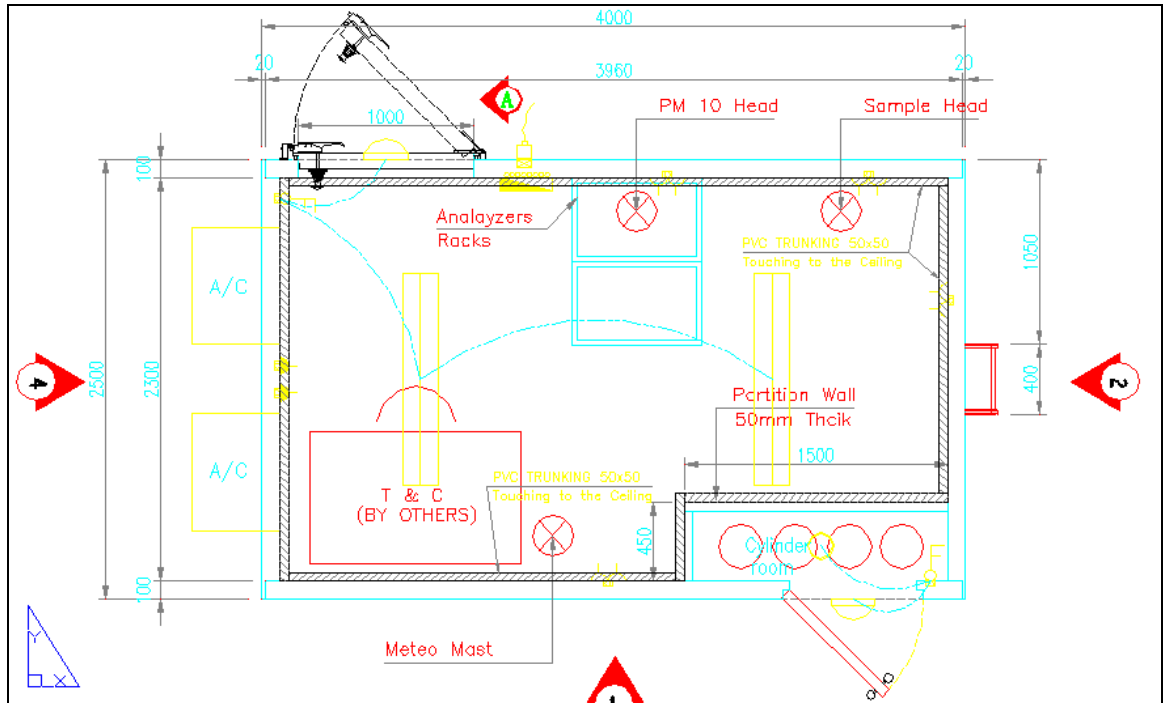
A shelter is required for housing the ambient air monitors and other equipment.

Qualification requirements

Shelter

1. The shelter must have sufficient size to house the equipment specified in this tender (including the option for a PM_{2.5} suspended particulate monitor), as well as the possibilities to install two additional monitors in the shelter in the future. The shelter design must allow for simultaneous measurements of both PM₁₀ and PM_{2.5} suspended particulates in ambient air.
2. All materials used for the construction of the shelter shall be new and of high quality and be resistant to humidity, dust, UV degradation and corrosive environment, as well as flameproof or flame retardant.
3. The outside surface shall be steel plated and painted white, without windows and with only one door with a door lock.
4. Gas cylinders shall be located inside a separate room with its own access door from the outside. There shall be access to gas cylinder compartment from inside the shelter through a small window that can be closed. This is to allow for opening and closing of gas cylinder regulators.
5. Teflon tubes shall run from the gas cylinder compartment along walls to the back of the instrument racks.
6. Walls, roof, floor and doors shall have sufficient isolation to maintain the requested indoor temperature taking into account the hot, humid and dusty conditions in Dakar. Requested indoor temperature: 20 - 30 °C adjustable, preferably stable within ± 2 °C. The shelter insulation must be sufficient to maintain the shelter temperature without putting undue strain on the AC units.
7. Proper cooling shall be provided by two wall mounted ACs in alternating operation, switching typically every two hours. The switching time shall be programmable. The indoor temperature shall be kept at 20 - 30 °C, selectable and preferably stable within ± 1 °C. Each bid must be accompanied by heat load calculations demonstrating that each AC unit can maintain the desired cooling with all equipment installed and operating at an outdoor temperature of approximately 50°C.
8. The shelter roof shall be able to withstand at least 400kg loading (supporting certificates from a recognised organisation must be submitted with the tender) and access to the roof shall be provided by a detachable ladder that can be fixed to the outer wall. The roof should be properly fenced against fall of persons working on it. The fence shall be removable.

Below is a drawing showing a suitable shelter.



Note: For stations with both PM₁₀ and PM_{2.5} measurements, a PM_{2.5} head is also necessary.

Drawings

- A drawing of the shelter with tower shall be delivered with the tender.

Racks

1. For safe mounting of the analysers, two of open 19" racks shall be installed in the shelter.
2. The instruments shall be easily inserted in and pulled out of the racks by a sliding mechanism and easily removable from the racks for maintenance.

Power requirements:

1. All instruments will run on 220V.
2. Minimum number of electric circuits: 3, each protected with switch breakers for:
 - Air condition
 - Monitors
 - Spare
3. An un-interrupted power supply (UPS) shall be installed in the shelter capable of running all instruments, data logger and PC for 5 minutes followed by a controlled automated shutdown.
4. The UPS shall be controlled by an external signal so that shutdown is initiated by high temperature inside the shelter.

Fire protection

1. The shelter shall include indoor air temperature sensor. The temperature shall be logged by the data logger. In case of high indoor temperature the temperature sensor shall instruct the UPS to shut down instruments. The temperature set point must be selectable.
2. The shelter shall include fire (smoke) detection and alarm system. The fire alarm shall initiate an audible and visual alarm both inside and outside the shelter. It must be possible for the temperature sensor to initiate instrument shutdown by the UPS.
3. One portable fire extinguisher shall be provided for interior electrical instrument fire suppression. The extinguisher shall use an extinguishing agent based on CO₂

Other

The shelter shall include one chair and one small workbench capable of holding a load of 100 kg for service of instruments.

3.1.2 Air intake with manifold for gas analysers**Quantity of equipment: 5****Purpose**

An air intake with manifold is required for delivering ambient air to the ambient air gas monitors inside the shelter.

Qualification requirements

1. Power requirements: 220 V.
2. Air intake of teflon supported by an outer steel or PVC tube. The air inlet shall extend to not less than 1.5 m above the roof.
3. Outer tube shall be easily removable for inspection and cleaning of teflon tube.
4. The outer tube shall end on a properly mounted flange on the roof through which the teflon tube runs.
5. Inside the shelter the teflon tube shall be connected to a glass manifold.
6. Manifold pump capable of supplying sufficient air to the ambient air gas monitors.
7. Heating of manifold to prevent water condensation. Both manifold and tubes from manifold to analysers shall be insulated.
8. Water trap.
9. Air intake mounted vertically through the roof.
10. Excess air from the air intake manifold and monitors must be ventilated outside the shelter.
11. A rotameter at the manifold vent shall indicate gas flow.

3.1.3 Two point calibration unit

Quantity of equipment: 5

Purpose

A two-point calibration unit is required at the shelter for performing weekly manual Zero/Span checks. The zero check shall be based on a zero air generator. The span check shall be based on a gas cylinder with “normal outdoor” concentration connected directly to the monitor without any dilution and without pressurising the monitor inlet. The zero air and span gas sources will be permanently connected to the zero and span gas ports respectively of the monitors.

Qualification requirements

1. Power requirements: 220 V.
2. Zero air generator capable of delivering zero air free from CO (<0.025 ppm), SO₂ (<0.5 ppb), NO (0.5 ppb), NO_x (<0.5 ppb) and NO₂ (<0.5 ppb).
3. Zero air shall be connected to the zero air input port on the monitors. A rotameter at the end of the zero air line shall indicate gas flow.
4. Individual NO (800 ppb), SO₂ (800 ppb), CO (20 ppm) and BTX (2 ppb each component) span gas cylinders (10% uncertainty) complete with SS regulators and tubing included for connecting the cylinders to the monitors.
5. Each span gas cylinder shall be connected to the span gas input port on the monitor at ambient pressure. For each monitor a rotameter shall indicate gas flow.
6. Span gases must have traceable certification of calibration.

The figure below shows a typical assembly of the Zero/Span system.

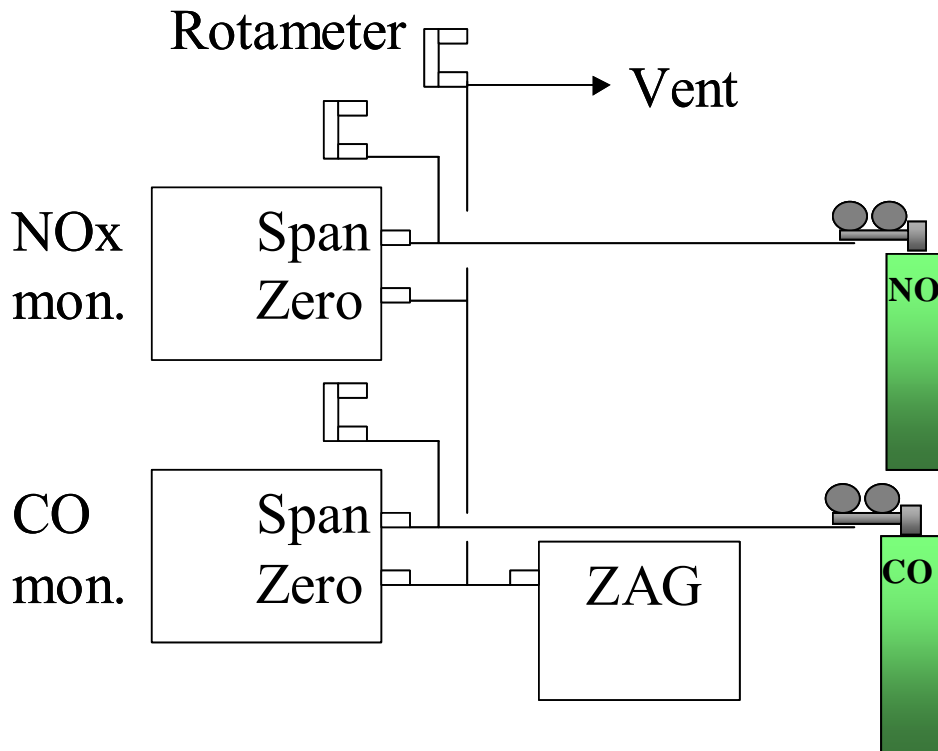


Figure 2 Typical assembly of the Zero/Span system

3.1.4 NO, NO_x, NO₂ ambient air monitor

Quantity of equipment: 5

Purpose

A NO, NO_x, NO₂ ambient air monitor is required for monitoring NO, NO_x and NO₂ in ambient air.

Qualification requirements

1. Power requirements: 220 V.
2. Measurement principle: Chemiluminescence, in accordance with the EC Directive 99/30/EC.
3. U.S. EPA designated.
4. Permapure drier for drying air to the O₃ generator. The use of silica gel as air drier is not acceptable.
5. Zero/Span valves and input ports. Zero and span gas shall run through the ambient air inlet filter of the monitor.
6. Data averaging time: 30 minutes maximum.
7. Rack mountable with rails included.
8. Output values (NO, NO₂, NO_x) proportional to measured values for connecting to the shelter data acquisition and control system.
9. Communication with data logger via RS232 serial communication port.

10. Complete schematic layout of all electric and pneumatic circuits for repair and maintenance.
11. Operating temperature: +5 °C to +40 °C.
12. Selectable measuring range: 0-50ppb to 0-20ppm.
13. Lower detectable limit: 0.5ppb.
14. Lag time: 20 seconds.
15. Rise and fall time: <60 seconds to 95%.
16. Linearity: 1% full scale.
17. Zero noise: <0.2ppb (RMS).
18. Span noise: <0.5% of reading (RMS) above 50ppb.

3.1.5 SO₂ monitor

Quantity of equipment: 3

Purpose

A SO₂ ambient air monitor is required for monitoring SO₂ in ambient air.

Qualification requirements

1. Power requirements: 220 V.
2. Measurement principle: U.V. fluorescence, in accordance with the EU Directive 99/30/EC.
3. U.S. EPA designated.
4. The use of silica gel as air drier is not acceptable.
5. Zero/Span valves and input ports. Zero and span gas shall run through the ambient air inlet filter of the monitor.
6. Data averaging time: 30 minutes maximum.
7. Rack mountable with rails included.
8. Output value proportional to measured value for connecting to the shelter data acquisition and control system.
9. Communication with data logger via RS232 serial communication port.
10. Complete schematic layout of all electric and pneumatic circuits for repair and maintenance.
11. Operating temperature: +5 °C to +40 °C.
12. Selectable measuring range: 0-50ppb to 0-20ppm.
13. Lower detectable limit: 0.5ppb.
14. Lag time: 20 seconds.
15. Rise and fall time: <120 seconds to 95%.
16. Linearity: 1% of full scale
17. Zero noise: <0.2ppb (RMS).
18. Span noise: <0.5% of reading (RMS) above 50ppb.

3.1.6 O₃ monitor

Quantity of equipment: 3

Purpose

An O₃ ambient air monitor is required for monitoring O₃ in ambient air.



Qualification requirements

1. Power requirements: 220 V.
2. Measurement principle: U.V. absorption, in accordance with the EU Directive 99/30/EC.
3. U.S. EPA designated.
4. The use of silica gel as air drier is not acceptable.
5. Data averaging time: 30 minutes maximum.
6. Internal zero air and O₃ generator.
7. Rack mountable with rails included.
8. Output value proportional to measured value for connecting to the shelter data acquisition and control system.
9. Communication with data logger via RS232 serial communication port.
10. Complete schematic layout of all electric and pneumatic circuits for repair and maintenance.
11. Operating temperature: +5 °C to +40 °C.
12. Selectable measuring range: 0-100ppb to 0-10 ppm.
13. Lower detectable limit: 0.6ppb.
14. Lag time: 10 seconds.
15. Rise and fall time: <20 seconds to 95%.
16. Linearity: 1% full scale.
17. Zero noise: 0.3 ppb (RMS).
18. Span noise: <0.5% of reading (RMS) above 100ppb.

3.1.7 CO monitor

Quantity of equipment: 2

Purpose

A CO ambient air monitor is required for monitoring CO in ambient air.

Qualification requirements

1. Power requirements: 220 V.
2. Measurement principle: Gas filter correlation, in accordance with the EU Directive 99/30/EC.
3. U.S. EPA designated.
4. The use of silica gel as air drier is not acceptable.
5. Zero/Span valves and input ports. Zero and span gas shall run through the ambient air inlet filter of the monitor
6. Data averaging time: 30 minutes maximum.
7. Rack mountable with rails included.
8. Output value proportional to measured value for connecting to the shelter data acquisition and control system.
9. Communication with data logger via RS232 serial communication port.
10. Complete schematic layout of all electric and pneumatic circuits for repair and maintenance.
11. Operating temperature: +5 °C to +40 °C.
12. Selectable measuring range: 0-1ppm to 0-1000 ppm.

13. Lower detectable limit: 0.04ppm.
14. Lag time: 10 seconds.
15. Rise and fall time: <60 seconds to 95%.
16. Linearity: 1% full scale.
17. Zero noise: 0.02 ppm (RMS).
18. Span noise: <0.5% of reading (RMS) above 5ppm.

3.1.8 BTX analyser

Quantity of equipment: 1

Purpose

A BTX ambient air monitor is required for monitoring BTX in ambient air.

Qualification requirements

1. Power requirements: 220 V.
2. Measurement principle: Gas Chromatograph (GC).
3. Detector: Photo Ionisation Detector (PID).
4. Carrier gas: Nitrogen.
5. Measuring cycle time: Maximum 30 minutes (2 measurements per hour).
6. Ranges: 0-200ppb.
7. Lower detectable limit: 0.15ppb.
8. Lag time: 15 minutes.
9. Noise: 0.07ppb.
10. Rack mountable with rails included.
11. Output values proportional to measured values for connecting to the shelter data acquisition and control system.
12. Communication with data logger via RS232 serial communication port.
13. Complete schematic layout of all electric and pneumatic circuits for repair and maintenance.
14. Complete spare part list with prices.
15. Operating temperature: +5 °C to +40 °C.

3.1.9 PM₁₀ suspended particulate monitor

Quantity of equipment: 5

Purpose

A PM₁₀ suspended particulate monitor is required for monitoring PM₁₀ suspended particulates in ambient air.

Qualification requirements

1. Power requirements: 220 V.
2. Measurement principle: Preferably Beta attenuation.
3. Data averaging time: 60 minutes maximum.
4. US EPA/R&P or EN12341 PM₁₀ head.
5. Rack mountable with rails included.



6. Output value proportional to measured value for connecting to the shelter data acquisition and control system.
7. Communication with data logger via RS232 serial communication port.
8. Complete schematic layout of all electric and pneumatic circuits for repair and maintenance.
9. Operating temperature: +5 °C to +40 °C.
10. Ranges: 0-5g/m³.
11. Lower detectable limit: 0.5 ug/m³.
12. Linearity: 1% full range.
13. Lag time: 10 seconds.
14. Noise: <1ug/m³ (one hour mean).

3.1.10 PM_{2,5} suspended particulate monitor

Quantity of equipment: 2

Purpose

A PM_{2,5} suspended particulate monitor is required for monitoring PM_{2,5} suspended particulates in ambient air.

Qualification requirements

15. Power requirements: 220 V.
16. Measurement principle: Preferably Beta attenuation.
17. Data averaging time: 60 minutes maximum.
18. US EPA/R&P or EN12341 PM_{2,5} head.
19. Rack mountable with rails included.
20. Output value proportional to measured value for connecting to the shelter data acquisition and control system.
21. Communication with data logger via RS232 serial communication port.
22. Complete schematic layout of all electric and pneumatic circuits for repair and maintenance.
23. Operating temperature: +5 °C to +40 °C.
24. Ranges: 0-5g/m³.
25. Lower detectable limit: 0.5 ug/m³.
26. Linearity: 1% full range.
27. Lag time: 10 seconds.
28. Noise: <1ug/m³ (one hour mean).

3.1.11 Low Volume Sequential Sampler

Quantity of equipment: 1

Purpose

A sequential low volume filter sampler is required to sample particulates in ambient air.

Qualification requirements

1. Power requirements: 220 V.

2. Principle of Operation : Gravimetric mass determination
3. Measurement Head : 10 μ m
4. Type: Kleinfiltergerät (KFG) according to EN12341.
5. Sampling Period : 1hr to 168 hrs (user selectable)
6. Flow Rate : 1-2.5m³/h (user selectable)
7. Flow Accuracy : < +2%
8. Operating Temperature : -5 to 50°C
9. Filter holders : 15 (unattended automatic filter changing user programmable)
10. Filter Diameter : 47-50mm
11. Control : microprocessor control fully programmable
12. Sampling Data Output : via RS232
13. Two extra cylinders for exposed filters and two extra cylinders for not-exposed filters, including two extra sets of filter holders.
14. Operation: 24 hours sampling every day.

3.1.12 Battery operated PM samplers

Quantity of equipment: 3

Purpose

A battery operated filter sampler is required to sample particulates in ambient air.

Qualification requirements:

1. Battery operated with rechargeable batteries and battery charger included.
2. Sampler and inlet shall be integrated in one unit.
3. Three (3) inlet heads for separation of PM₁₀ particles.
4. Two (2) inlet heads for separation of PM_{2.5} particles.
5. 7 day timer with programmable start and stop time, typical sampling time is 24 hours,
6. Total flow indicator.
7. US EPA designation or documented testing of equivalence, e.g. according to EN12341.
8. Sampler must include necessary equipment for fixing the sampler to a pole.
9. Complete schematic layout of all electric and pneumatic circuits for repair and maintenance.
10. Complete spare part list with prices.
11. Filter Diameter : 47-50mm.
12. Filter must be placed in filter holders prior to insertion in sampler.
13. Ten extra filter holders.
14. Operation: 24 hours sampling once a week.

3.1.13 Meteorology sensors

Quantity of equipment: 1

Purpose

Meteorology sensors are required for monitoring meteorology in ambient air.



Qualification requirements

The meteorological tower shall be connected to the monitoring shelter at the HLM4 site (see Table 1).

All the sensors shall fulfil the following requirements:

- Power requirements: 220V.
- The sensors shall be able to withstand the harsh environmental conditions in Dakar

Wind Speed and Turbulence Sensor:

- Range: 0-50 m/s
- Accuracy: $\pm 2\%$ at wind speed in excess of 5 m/s
- Resolution: 0.1 m/s
- Starting Threshold: 0.5 m/s
- Operating Temperature: -30°C to $+55^{\circ}\text{C}$
- Preferable Ultra Sonic Sensor or similar equipment

Wind Direction Sensor:

- Range: 0-360 degrees
- Accuracy: $\pm 5^{\circ}$
- Resolution: 1 degree
- Starting Threshold: 0.5 m/s
- Operating Temperature: -15°C to $+55^{\circ}\text{C}$
- Preferable Ultra Sonic Sensor or similar equipment

Relative Humidity Sensor:

- Range: 0-100%
- Temperature range: -15°C to $+60^{\circ}\text{C}$
- Accuracy: $\pm 2\%$ for 0-90%, $\pm 3\%$ for 90-100%

Ambient Temperature Sensor at 2 and 10 meter:

- Range: -15°C to $+60^{\circ}\text{C}$
- Accuracy: $\pm 0.05^{\circ}\text{C}$ throughout the entire range
- Fan aspirated temperature shield that allow for easy maintenance and access to sensors
- Outer surface highly reflective and corrosion resistant
- Delta T measurements to be included

Net Radiation Sensor:

- Spectral Range: 0.3-60 microns
- Range: $\pm 2000 \text{ W/m}^2$
- Sensitivity: 10 V/W/m^2
- Response time (1/e): 20 sec nominal
- Operating Temperature: -15°C to $+60^{\circ}\text{C}$



Atmospheric Pressure Sensor:

- Range: 660mm to 813 mmHg
- Operating Temperature: -15°C to +60°C
- Accuracy: $\pm 0.2\%$ of Full Scale

The meteorological tower

- 10 m telescopic meteorological tower fixed to the shelter. The tower shall be an integrated part of the shelter.
- The tower must be able to withstand winds up to 50m/s (supporting certificates to shall be submitted).
- The tower must withstand the highly corrosive and abrasive environment of Dakar
- The tower shall be equipped with lightning protection
- The tower shall have a transorb for each sensor to prevent sensor damage should a lightning occur.

3.1.14 Shelter data acquisition system

Quantity of equipment: 5

Purpose

A data acquisition and control system is required at each shelter to sample data and instrument status from the ambient air monitors.

Qualification requirements

1. Power requirements: 220 V.
2. The data acquisition system must be able to communicate with the central data collection system.
3. Capable of collecting data from the ambient air monitors at the shelter depending on the instrument configuration.
4. It must be possible to download data to a PC at the station in case of telephone line fallout. The downloaded data format must be compatible with the data import format used by the central management system.
5. Maximum sampling period: Ca. 10 sec.
6. Compute and store 1 hour and preferably 5 minute averages.
7. Storage capacity: 3 months of hourly averages and 21 days of 5 min. averages.
8. The data communication between the instruments and the data logger shall be based on RS232 serial communication.
9. All analogue and digital I/O channels and RS232 ports must be galvanically separated from the instrumentation.
10. Data logging during zero/span checks shall be automatically flagged as such.
11. Alarms from the monitors shall be stored.
12. The system must include all necessary equipment for communication with the computer centre via (GSM) modem and public telephone lines.
13. Operating temperature: +5 °C to +30 °C.



3.2 Air Quality Monitoring System

As a minimum, the Air Quality Monitoring System should consist of:

1. An automatic central data collection application.
2. An online monitoring system.
3. A measurement data base for meteorology and air quality.

The data entering application shall as a minimum contain functionality of calibration and quality assurance of the data to be transferred.

The Measurement Module should be a tool for managing air quality and meteorological measurements with the following minimum requirements:

1. Capacity for a total number of shelters in network (approx.): 30.
2. Capacity for a total number of logged parameters in all shelters (approx.): 150 including ambient air and meteorological parameters.
3. Data collection interval: Hourly or daily depending on the shelter location.
4. The system must include all necessary equipment for communication with shelters via modem and public telephone lines, leased line, radio e.t.c.
5. Data presentation software capable of displaying and printing both historical and on line data in charts and listings (reports).
6. Report printed automatically at user defined intervals.
7. Tools for flagging invalid data, e.g. spikes, zero/span check data, instrument failures, e.t.c.
8. Remote configuration of data logger in shelter.
9. The software must run on a PC and be Windows based.
10. The system shall be able to export any measurement data in tabular (fixed column) format to an ASCII file. The system shall preferably export one component per ASCII file. It shall be possible to initiate data export manually by specifying components and time period. It shall be possible to initiate automatic data export where data is exported to an ASCII file automatically every hour after data collection. The data file will be picked up by the AirQuis software (www.airquis.no) for further data processing.

An example ASCII export file is shown below.

From time	To time	Value	Flags
2006.06.12 14:00	2006.06.12 15:00	24.6	102
2006.06.12 15:00	2006.06.12 16:00	27.3	102

Flags can be validity flags, status flags, e.t.c.

The system must be delivered complete with a PC for the central data collection at the laboratory and all necessary hardware.

3.3 Calibration laboratory

An overview of the necessary equipment for the Calibration laboratory is given in Table 4.

Table 4: *Equipment for Calibration laboratory.*

Monitors
NO _x , same specs as for AQ station monitor
SO ₂ , same specs as for AQ station monitor
O ₃ , same specs as for AQ station monitor
CO, same specs as for AQ station monitor
BTX, same specs as for AQ station monitor
Multipoint Calibration Unit
Multipoint calibrator with ozone photometer and GPT, 4 inlet ports
Zero Air Generator with CO converter
Flow calibrator - portable, ranges 2.5 ml/min – 20 l/min
Reference gases
100 ppm NO span gas in Nitrogen including Stainless Steel (SS) regulator
100 ppm SO ₂ span gas in Nitrogen including SS regulator
2000 ppm CO span gas in Nitrogen including SS regulator
200 ppb BTX span gas in Nitrogen including SS regulator
Tubing between cylinders and calibrator should be 1/8 inch SS
Secondary reference gases
800 ppb NO span gas in Nitrogen including SS regulator
800 ppb SO ₂ span gas in synthetic air including SS regulator
20 ppm CO span gas in synthetic air including SS regulator
2 ppb BTX span gas in Nitrogen including SS regulators
Other gases
5.0 Nitrogen including regulator
Balance
Micro balance for filter-weighing
Climate control
Temperature, Pressure and RH-sensor with display, connected to data logger
Air conditioners
CO detector
Data handling
Stationary PC w/MS Office and data logger software
Portable PC w/MS Office and data logger software
Data acquisition and control system, same as at AQ station
Printers
Racks, maintenance tools kit, etc.
Double rack for monitors
Maintenance tools kit
General items for Calibration lab

3.3.1 Thermometer for measuring room temperature

Quantity of equipment: 2

Purpose

A Thermometer for measuring room temperature is required.

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Resolution: 0.1°C.
3. Display: Digital, °C.
4. Certification of calibration.
5. Output signal proportional to measured value for connecting to the Calibration lab data acquisition and control system.

3.3.2 Barometer for measuring room pressure

Quantity of equipment: 1

Purpose

A barometer for measuring room pressure is required.

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Resolution: 1mBar.
3. Display: Digital, mBar, if possible selectable mBar, torr or psi.
4. Certification of calibration.
5. Output signal proportional to measured value for connecting to the Calibration lab data acquisition and control system.

3.3.3 Hygrometer for measuring room humidity

Quantity of equipment: 2

Purpose

A hygrometer for measuring the room humidity is required.

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Resolution: 1 %.
3. Display: Digital, %.
4. Certification of calibration.
5. Output signal proportional to measured value for connecting to the Calibration lab data acquisition and control system.

3.3.4 *Micro balance for filter-weighing*

Quantity of equipment: 1

Purpose

A micro balance is required for weighing the filters from the Low Volume Sequential Sampler (see specifications in 3.1.11) and from the Battery operated PM samplers (see specifications in 3.1.12).

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Accuracy: 1 μg .
3. Readability: 0.001 mg.
4. Repeatability: 1 μg .
5. Display: Digital.
6. Filter Diameter: up to 50mm.
7. Certification of calibration.
8. Reference masses for calibration: 100 mg and 500 mg.
9. A static discharger for filters, in case they are not of glass fibre or quartz

3.3.5 *Air conditioners*

Quantity of equipment: 4

Purpose

The purpose of each air-conditioner is:

1. To maintain the temperature inside the calibration laboratory at $20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.
2. To maintain the temperature inside the weighing room constant to $20\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ and constant relative humidity to $50 \pm 5\%$.
3. To maintain the temperature in the room communicating with the weighing room constant to $20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ and constant relative humidity to $50 \pm 5\%$.
4. To maintain the temperature inside the calibration laboratory at $20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.

Qualification requirements

1. Power requirements for all air-conditioners: 220 - 240 V.
2. The air conditioner for the calibration laboratory must maintain the temperature inside at $20\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$. The instrument laboratory is 6.3 x 3.5 squared meters and will have instruments giving a warming effect up to 6 kilowatt/hour. Three of the walls in the laboratory are external walls and it will have 2 windows.
3. The air conditioner for the weighing room must maintain the temperature inside the room constant to $20\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$ and constant relative humidity to

50 ± 5 %. The weighing room is 2 x 2.5 square meters and will have up to two persons working. The room will not have windows, but two of its walls are external walls.

4. The air conditioner for the room communicating with the weighing room must maintain the temperature inside the room constant to 20 °C ± 3 °C and constant relative humidity to 50 ± 5 %. This room is 7.5 squared meters.
5. The air conditioner for the “salle informatique” must maintain the temperature inside at 20 °C ± 5 °C. The room is 5.7 x 3.5 squared meters.

3.3.6 CO detector

Quantity of equipment: 1

Purpose

A CO detector is required to detect hazardous levels of CO in the room air.

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Audible and visible alarm.
3. Measurement range: 1000 ppm.
4. Alarm limit: 100 ppm.
5. Output signal proportional to measured value for connecting to the Calibration lab data acquisition and control system.

3.3.7 Zero air generator with CO converter

Quantity of equipment: 1

Purpose

A zero air generator is required to produce zero air for calibration of ambient air monitors as well as for diluting span gases in the multigas multipoint calibrator.

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Capable of delivering zero air free from CO (<0.025 ppm), SO₂ (<0.5 ppb), NO (0.5 ppb), NO_x (<0.5 ppb), NO₂ (<0.5 ppb), O₃ (<0.5 ppb) and hydrocarbons (<0.02 ppm).
3. Water trap included.
4. Pump included.
5. Output pressure: Minimum 7 bar or sufficient to supply the multigas multipoint calibration system.
6. Output flow rate: Minimum 10 l/min or sufficient to supply the multigas multipoint calibration system.
7. Tubing in inert material, e.g. teflon or stainless steel.

3.3.8 *Multigas multipoint calibration system*

Quantity of equipment: 1

Purpose

A Multigas multipoint calibration system is required for dynamic calibrations of ambient air monitors.

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Number of calibration gas input ports: minimum 4.
3. Dilution air flow range: 0 - 10 l/min.
4. Cylinder gas flow range: 0 - 100 ml/min.
5. Certification of calibration of the mass flow controllers.
6. U.V. photometer with O₃ generator for dynamic calibration of O₃ monitors.
7. O₃ output: 6 ppm litres, maximum flowrate: 6 l/min.
8. A separate U.V. photometer with O₃ generator is also acceptable.
9. Programmable calibration sequence for automatic unattended operation.
10. Complete control of calibrator (setting flow rates/ output concentrations) via RS232 communication port using the laboratory data acquisition and control system.
11. Complete documentation of RS232 communication commands.
12. Complete schematic layout of all electric and pneumatic circuits for repair and maintenance.
13. Operating temperature: +15 °C to 30 °C.
14. Necessary tubing in inert material for assembling the Multigas multipoint calibration system with the different gas cylinders.

3.3.9 *Primary calibration gas standard of NO*

Quantity of equipment: 1

Purpose

A primary calibration gas cylinder of NO is required as the national reference calibration gas standard for NO in the traceability chain.

Qualification requirements

1. 100 ppm NO in N₂
2. Uncertainty < 1%
3. Including SS regulator
4. Traceable certification of calibration
5. 5 years validity

3.3.10 Primary calibration gas standard of SO₂

Quantity of equipment: 1

Purpose

A primary calibration gas cylinder of SO₂ is required as the national reference calibration gas standard for SO₂ in the traceability chain.

Qualification requirements

1. 100 ppm SO₂ in N₂
2. Uncertainty < 1%
3. Including SS regulator
4. Traceable certification of calibration
5. 5 years validity

3.3.11 Primary calibration gas standard of CO

Quantity of equipment: 1

Purpose

A primary calibration gas cylinder of CO is required as the national reference calibration gas standard for CO in the traceability chain.

Qualification requirements

1. 2000 ppm CO in N₂
2. Including SS regulator
3. Traceable certification of calibration
4. Uncertainty < 1%
5. 5 years validity

3.3.12 Primary calibration gas standard of BTX

Quantity of equipment: 1

Purpose

A primary calibration gas cylinder of BTX is required as the national reference calibration gas standard for BTX in the traceability chain.

Qualification requirements

1. 200 ppb benzene, toluene and xylene in N₂.
2. Uncertainty < 1%
3. Including SS regulator
4. Traceable certification of calibration
5. 5 years validity

3.3.13 Secondary calibration gas standard of NO

Quantity of equipment: 1

Purpose

A secondary gas cylinder of NO is required as a travelling calibration standard to control NO_x-monitors at the stations during audit visit.

Qualification requirements

1. 800 ppb NO in N₂
2. Uncertainty < 10%
3. Including SS regulator
4. Traceable certification of calibration
5. 1 year validity

3.3.14 Secondary calibration gas standard of SO₂

Quantity of equipment: 1

Purpose

A secondary gas cylinder of SO₂ is required as a travelling calibration standard to control SO₂-monitors at the stations during audit visit.

Qualification requirements

1. 800 ppb SO₂ in synthetic air
2. Uncertainty < 10%
3. Including SS regulator
4. Traceable certification of calibration
5. 1 year validity

3.3.15 Secondary calibration gas standard of CO

Quantity of equipment: 1

Purpose

A secondary gas cylinder of CO is required as a travelling calibration standard to control CO -monitors at the stations during audit visit.

Qualification requirements

6. 20 ppm CO in synthetic air
7. Uncertainty < 10%
8. Including SS regulator
9. Traceable certification of calibration
10. 1 year validity

3.3.16 Secondary calibration gas standard of BTX

Quantity of equipment: 1

Purpose

A secondary gas cylinder of BTX mixture is required as a travelling calibration standard to control BTX -monitors at the stations during audit visit.

Qualification requirements

11. 2 ppb benzene, toluene and xylene in N₂.
12. Uncertainty < 10%
13. Including SS regulator
14. Traceable certification of calibration
15. 1 year validity

3.3.17 Nitrogen as carrier gas for BTX monitors

Quantity of equipment: 1

Purpose

To be used as carrier gas for BTX monitor.

Qualification requirements

1. N₂ of quality 5.0
2. Including regulator
3. 1 year validity

3.3.18 BIOS gas flow calibrator

Quantity of equipment: 1

Purpose

A BIOS gas flow calibrator is required to calibrate PM monitors and gas calibrators.

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Range: 2.5 – 20 l/min.
3. Traceable certification of calibration of the gas flow meter.
4. It must be possible to both push and pull the air through the meter.
5. Accuracy: 0.25% of full scale.



3.3.19 NO, NO_x, NO₂ calibration lab monitor

Quantity of equipment: 1

Purpose

A NO, NO_x, NO₂ ambient air monitor is required for measuring NO and NO₂ span gases. The span gas will be supplied to the monitor inlet port at ambient pressure.

Qualification requirements

- Same as for AQ station monitor.

3.3.20 SO₂ calibration lab monitor

Quantity of equipment: 1

Purpose

A SO₂ ambient air monitor is required for measuring SO₂ span gas. The span gas will be supplied to the monitor inlet port at ambient pressure.

Qualification requirements

- Same as for AQ station monitor.

3.3.21 O₃ calibration lab monitor

Quantity of equipment: 1

Purpose

An O₃ ambient air monitor is required as the national reference standard for O₃.

Qualification requirements

- Same as for AQ station monitor.

3.3.22 CO calibration lab monitor

Quantity of equipment: 1

Purpose

A CO ambient air monitor is required for measuring CO span gas. The span gas will be supplied to the monitor inlet port at ambient pressure.

Qualification requirements

- Same as for AQ station monitor.



3.3.23 BTX calibration lab monitor

Quantity of equipment: 1

Purpose

A BTX ambient air monitor is required for measuring BTX span gas.

Qualification requirements

- Same as for AQ station monitor.

3.3.24 Rack for monitors, calibrators, etc.

Quantity of equipment: 2

Purpose

A rack is required for the Calibration lab ambient air monitors, calibrators, zero air generator and data logger.

Qualification requirements

1. Floor mounted rack for mounting the ambient air monitoring calibration lab equipment.
2. Number of units in the rack: 6 - 9 including data logger.

3.3.25 Calibration lab data acquisition and control system

Quantity of equipment: 1

Purpose

A data acquisition and control system is required to log data from ambient air monitor sensors and the multigas multipoint calibration system during calibration and tests.

Qualification requirements

- Same as for AQ stations.

3.3.26 Calibration lab repair and maintenance tools kit

Quantity of equipment: 1

Purpose

A complete set of repair and maintenance tools including a toolbox is required for repair and maintenance work in the laboratory.

ITEM	Quantity	Other properties
Toolbox, suitcase type, including:	1	AC / DC
Screwdriver, slotted, 2.5x80 mm	1	
Screwdriver, slotted, 4x100 mm	1	
Screwdriver, slotted, 5.5x100 mm	1	
Screwdriver, supadriv, No 0x80	1	
Screwdriver, supadriv, No 1x80	1	
Screwdriver, supadriv, No 2x100	1	
Multimeter, digital, V, A, Ohm	1	
Spanner, adjustable, 15 mm jaw	1	
Spanner, adjustable, 35 mm jaw	1	
Knife, cut, 100 mm blade	1	
Rod, measuring, 1 m	1	
Tweezer, flat nose	1	
Optical inspection mirror, 165mm	1	
Spanner, combination, 7 mm	1	
Spanner, combination, 8 mm	1	
Spanner, combination, 9 mm	1	
Spanner, combination, 10 mm	1	
Spanner, combination, 11 mm	1	
Spanner, combination, 12 mm	1	
Spanner, combination, 13 mm	1	
Spanner, combination, 14 mm	1	
Spanner, combination, 15 mm	1	
Spanner, combination, 16 mm	1	
Spanner, combination, 17 mm	1	
Spanner, combination, 3/16"	1	
Spanner, combination, 1/4"	1	
Spanner, combination, 5/16"	1	
Spanner, combination, 3/8"	1	
Spanner, combination, 7/16"	1	
Spanner, combination, 1/2"	1	
Spanner, combination, 9/16"	1	
Spanner, combination, 5/8"	1	
File, needle, warding	1	
File, needle, round	1	
Cutter, wire, 150 mm	1	
Ball hexagon driver, L shaped, 9 piece set, 1.5 mm - 10 mm	1	
Ball hexagon driver, L shaped, 9 piece set, 0.05" - 5/16"	1	
Pliers, combination, 160 mm	1	
Hacksaw, small incl. spare blades	1	
Wire stripper	1	
Soldering iron, 230 V, 18 W	1	
Caliper, 7" / 180 mm	1	
Pocket, handlamp	1	

3.3.27 Calibration laboratory items

Purpose

General items for Calibration lab.

ITEM	Minimum quantity	Qualification requirements	
		Maximum	Other properties
1/4" teflon tubing	30 m		Unit (metric or imperial) depends on unit used in ambient air monitors
1/8" teflon tubing	10 m		
4 mm inner/ 10 mm outer silicon tubing	10 m		
Reducing union SS 1/4" - 1/8"	5		
Union SS 1/8"	5		
Union SS 1/4"	5		
Union elbow SS 1/4"	5		
Union tee SS 1/4"	5		
Union tee SS 1/8"	5		
Plug SS 1/8"	10		
Plug SS 1/4"	10		
Cap SS 1/8"	5		
Cap SS 1/4"	5		
Nut SS 1/4"	10		
Nut SS 1/8"	10		
Ferrule-pak SS 1/4"	1 á 100 pcs		
Ferrule-pak SS 1/8"	1 á 100 pcs		
Port connector SS 1/4"	5		
Male elbow B 1/4"-1/4"	10		
Union B 1/4"	5		
Union tee B 1/4"	5		
Nut B 1/4"	10		
Ferrule-pak B 1/4"	1 á 100 pcs		
1/4" Y-piece	100		

3.3.28 Calibration lab UPS

Quantity of equipment: 3

Purpose

Three un-interrupted power supply (UPS) shall be installed in the calibration lab capable of running the following equipment:

1. One UPS shall be dimensioned to run all the calibration lab monitors, calibrator, zero gas generator and the data logger for 5 minutes followed by a controlled automated shutdown;
2. One UPS shall be dimensioned to run 5 extra monitors brought to the calibration lab from the measurement stations for maintenance and calibration;
3. One un-interrupted power supply (UPS) shall capable of running the lab PC and a server for 15 minutes followed by a controlled automated shutdown.

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Capacity requirements for the two UPS connected to the monitors is 3 kilowatts/hour.

3.3.29 Calibration lab computer

Quantity of equipment: 1

Purpose

A stationary PC is required for data acquisition and data display and control of the calibration system.

Qualification requirements

3. Power requirements: 220 - 240 V.
4. Minimum clock rate: 3 GHz.
5. Minimum RAM capacity: 1 Gbyte.
6. Minimum hard disk capacity: 120 Gbyte.
7. 1 Serial port and 5 USB ports.
8. Windows, latest version.
9. MS Office, latest version.
10. Data acquisition and control software as specified in 3.3.25 Calibration lab data acquisition and control system.
11. Calibration software as specified in 3.3.8 Multigas multipoint calibration system.
12. Necessary interface and cables for connecting the PC to the data logger and calibration system.

13. The bidder must specify additional specifications if any of the specifications above do not meet the necessary conditions.

3.3.30 Calibration lab portable computer

Quantity of equipment: 1

Purpose

A portable PC is required for data acquisition and data display and control of the calibration system.

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Minimum clock rate: 1,5 GHz.
3. Minimum RAM capacity: 512 Mbyte.
4. Minimum hard disk capacity: 80 Gbyte.
5. Serial port and USB ports.
6. Windows, latest version.
7. MS Office, latest version.
8. Data logger software or software capable of communicating with the shelter data logger depending on bidder's solution.
9. The bidder must specify additional specifications if any of the specifications above do not meet the necessary conditions.

3.3.31 Portable computer for CGQA

Quantity of equipment: 1

Purpose

A portable PC is required for the CGQA for work outside the office and presentations.

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Minimum clock rate: 2 GHz.
3. Minimum RAM capacity: 1 Gbyte.
4. Minimum hard disk capacity: 80 Gbyte.
5. Serial port and USB ports.
6. DVD/CD-ROM drive and burner.
7. Wireless network connection.
8. Windows, latest version.
9. MS Office, latest version.

3.3.32 Lab printers

Quantity of equipment: 1

Purpose

A printer is required for printing data from the Calibration lab PC.

Qualification requirements

1. Power requirements: 220 - 240 V.
2. Any laser or ink jet printer.
3. Single sheet feeder.

Quantity of equipment: 1

Purpose

A printer is required for printing reports and documents.

Qualification requirements

4. Power requirements: 220 - 240 V.
5. Colour laser jet printer, with separate black ink patron.
6. Multiple sheet feeder.

4 Vendor list

4.1 Gas monitors

Environnement S.A
111, bd Robespierre
78300 Poissy, France
www.environnement-sa.com

Environics, Inc.
69 Industrial Park Rd. E.
Tolland, CT 06084-2805
(203) 429-0077, USA
www.environics.com

Horiba Instruments Incorporated
17671 Armstrong Avenue
Irvine, CA 92714
(800) 446-7422, USA
www.horiba.com

Teledyne - Advanced Pollution
Instrumentation, Inc.



6565 Nancy Ridge Drive
San Diego, CA 92121-2251
(619) 657-9800, USA
www.teledyne-api.com

Dasibi Environmental Corp.
[506 Paula Avenue
Glendale, CA 91201
(818) 247-7601, USA
www.dasibi.com

Monitor Europe Ltd.
Block 9 Bedlay View
Tannochside Park
Uddingston
Scotland
G71 5PE
01242 663938
www.monitoreurope.com

Thermo Electron Corporation
27 Forge Parkway
Franklin, MA 02038, USA
(508) 520-0430 / (866) 282-0430
www.thermo.com

4.2 PM monitors

Andersen Instruments
[Refer to Thermo Electron Corporation]
www.thermoandersen.com

Rupprecht & Patashnick Co., Inc.
[Refer to Thermo Electron Corporation]
25 Corporate Circle
Albany, NY 12203
(518) 452-0065
www.rpco.com

Met One Instruments, Inc.
1600 Washington Blvd.
Grants Pass, OR 97526
(541) 471-7111
www.metone.com

4.3 PM samplers

Ingenieurbüro Norbert Derenda



Iserstraße 8-10
D-14513 Teltow, Germany
+49 3328 332750
www.derenda.de

Sven Leckel
Ingenieurbüro GmbH
Leberstraße 63
D-10829 Berlin, Germany
+49 (0)30 - 78 95 50 11
www.leckel.de

Thermo Electron Corporation
27 Forge Parkway
Franklin, MA 02038, USA
(508) 520-0430 / (866) 282-0430
www.thermo.com

Rupprecht & Patashnick Co., Inc.
25 Corporate Circle
Albany, NY 12203
(518) 452-0065
www.rpco.com

Met One Instruments, Inc.
1600 Washington Blvd.
Grants Pass, OR 97526
(541) 471-7111
www.metone.com

Airmetrics
2121 Franklin Boulevard, #9
Eugene, Oregon 97403, USA
(541) 683-5420
<http://www.airmetrics.com>

4.4 Meteorology sensors and towers

Met One Instruments, Inc.
1600 Washington Blvd.
Grants Pass, OR 97526
(541) 471-7111
www.metone.com

Aanderaa
PO Box 160 Nesttun
5852 Bergen
Norway



+47 55 109900
www.aanderaa.no

Vaisala
P.O. Box 26, FIN-00421 Helsinki
Finland
+358 9 894 91
www.vaisala.com

5 Construction and installations specifications

The client will assure access to electricity and telephone near the shelters. It is the responsibility of the bidder to install cables from the closest switch box.

5.1 Monitoring sites

Each monitoring site should be equipped with:

- A concrete platform suitable for the shelter
- Four anchors for the met. tower guy wires. It is assumed that the tower is mounted on the shelter.
- Electricity, 220 V
- Telecommunication line for data transfer, analog, ISDB or broadband + one for standard telephone
- Fence with gate and lock around shelters and meteorological tower, as indicated in Table 5.

Table 5: *Need of safety fence around the shelters, considering the first alternative for the location of each permanent station.*

Site	Name	Type	Alternative	Safety fence
1	Boul. Rep	UT	Pl. Soweto	Need fence
2	Medina	ST		Seem safe, inside gate
3	HLM4	UB		Need fence
4	BelAir	UI		On roof, no fence
5	Yof	RB	Golf club	Need fence

*U – Urban T – Transport
 S – Suburban B – Background
 R – Regional I – Industrial

5.2 Shelter dimensions

The shelter shall be large enough to contain the equipment described above.

Typical size can be:

Length: 6,0 m Width: 2,5 m Height: 2,6 m



6 Commissioning and testing requirements

The entire system shall be tested as a site acceptance test for at least one week (minimum 168 hours). The bidder shall provide a test protocol for approval and witness to document this shake-down period by summarizing as a minimum (where applicable):

- Instruments:
 - Mechanical and electrical inspection
 - Adjustments and calibrations
 - Span drift, 1 day and 7 days
 - Zero drift, 1 day and 7 days
- Shelter, tubing and wiring
- Alarm handling
- Data communication between
 - Shelter and central data base
 - Performance test results on data flow

The bidder shall provide engineering drawings (prior to installation and as built after installation) including integration, electrical design and communication solution. Drawings shall be approved by the Client prior to installation.

7 Training requirements

To ensure correct operation of instruments and data collection system a training program shall be developed and carried out. The training programme shall commence right after commissioning and testing. It should last for at least 2 weeks and consist of both classroom training and hands-on training in instrument operations.

7.1 Training in instrument operation

The following topics shall as a minimum be included in the training programme for instrument operations and maintenance:

- Instrument installations
- Instrument calibrations
- Instrument operations
- Preventive maintenance
- Data acquisition system
- Status checking
- Simple repairs of instruments
- QA/QC system relating to instrument operations



7.2 Training in data collection and data validation

The following topics shall as a minimum be included in the training programme for data collection and data validation at site level:

- Data collection from sensors / shelters
- Data validation
- Data system maintenance and operation
- QA/QC system relating to data collection and validation

8 References

Sivertsen, Bjarne (2006) Programme de contrôle de la Qualité de l'Air à Dakar, Résultat de l'étude de conception. Kjeller (NILU OR 71/2006).



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ABSTRACT Financed by the Nordic development Fund (NDF), the Norwegian Institute for Air Research (NILU) is supporting the Conseil Exécutif des Transports Urbains de Dakar (CETUD) in establishing a Central Laboratory with an Air Quality Management System for Dakar. This report contains all relevant physical technical specifications for the Monitoring Network and Calibration laboratory for air quality and meteorological measurements. The report also includes commissioning, testing and training requirements.		
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