WHO COLLABORATING CENTRE FOR AIR QUALITY
MANAGEMENT AND AIR POLLUTION CONTROL

at the
FEDERAL ENVIRONMENTAL AGENCY

STATUS REPORT ON QUALITY ASSURANCE AND QUALITY CONTROL IN AIR MONITORING NETWORKS

- Central and Eastern Countries of the
WHO European Region -

Markus Kollar
Hans-Guido Mücke

REPORT 14

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WHO Collaborating Centre for Air Quality Management
and Air Pollution Control
– Federal Environmental Agency –

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Air Hygiene Report 14

Markus Kollar * and Hans-Guido Mücke *

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PREFACE

Quality assurance and quality control to support air quality monitoring networks of the WHO European Region have gained a long tradition meanwhile for the WHO Collaborating Centre for Air Quality Management and Air Pollution Control (WHO CC) at the German Federal Environmental Agency (UBA), Berlin. A valuable effect of intercomparison workshops on air quality monitoring conducted by the WHO CC in co-operation with the UBA Pilotstation in Langen, Germany, is the exchange of information with and between the air quality monitoring networks from different countries.

This publication is an additional contribution to improve the process of harmonising air quality monitoring at the international level. Furthermore, it may serve as an opportunity to reflect the design and measurement strategy of an air quality monitoring network in line with recommendations of the WHO monograph on Monitoring Ambient Air Quality for Health Impact Assessment (WHO 1999).

We would like to express our gratitude to all participants who responded to our questionnaire, who gave us additional information on their networks and co-operated productively with us during the evaluation process. Many thanks are addressed to Elfriede Huber for her constructive comments, the accurate transfer of data to the tables and her support for the layout.

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ABSTRACT

This report reflects the current status of and major quality assurance and quality control (QA/QC) activities in 13 air quality monitoring networks from 11 Central and Eastern Member States of the WHO European Region.

The survey is based on a questionnaire, which comprises 20 questions concerning the design and the legal basis of a network, information on monitoring sites, measurement methods for CO, SO_2, NO, NO_2, BTX, TSP, and PM_{10}, QA/QC measures performed, data management and report of data. The situation of the networks is described for the year 1999.

The discussion brings together QA/QC programmes of the networks and requirements according to the WHO European Centre for Environment and Health, Bilthoven, Netherlands, for the use of air quality data for health impact assessment (HIA) of air pollution.

The following conclusions are drawn in this report:

- The location of stations of the air quality monitoring networks, which are relevant for exposure of the majority of the population, often restricts HIA.
- Incomplete temporal data coverage and spatial distribution for the pollutants CO, O_3, TSP and PM_{10} in many networks will probably restrict HIA.
- Manual measurement methods lead to incomplete temporal data coverage.
- Harmonisation needs are identified for the QA/QC activities concerning site visit functions, audits and intercalibrations of the networks.
- The data quality objectives with respect to accuracy and precision, capture rates and formats for reporting of data should be harmonised to improve the reliability and comparability of data and to facilitate HIA.

Thus, the exchange of experience and information should be supported in the future. As an outcome of this status report and from discussion with the participants, it is recommended to increase the financial expenditures for the improvement of the QA/QC programmes in many of the networks surveyed. It is also recommended to revise and update the design of air monitoring networks by increasing the number of stations at exposure-relevant sites.

(Key words: Air quality monitoring, quality assurance, quality control, Central and Eastern Europe, health impact assessment)

LIST OF TABLES AND FIGURES

ABBREVIATIONS AND SYMBOLS

AirQ	Air Quality Health Impact Assessment Software Tool
BTX	Benzene, toluene, xylene
CO	Carbon monoxide
EMEP	Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
EU	European Union
EUROAIRNET	European Air Quality Monitoring and Information Network
GAW	Global Atmosphere Watch
HIA	Health impact assessment
JRC/ERLAP	Joint Research Centre/European Reference Laboratory for Air Pollution
NO	Nitrogen monoxide
NO_2	Nitrogen dioxide
O_3	Ozone
PM	Particulate matter
QA/QC	Quality assurance/quality control
SO_2	Sulphur dioxide
TSP	Total suspended particulates
UN/ECE	United Nations Economic Commission for Europe
WHO	World Health Organization
WHO CC	WHO Collaborating Centre for Air Quality Management and Air Pollution Control
WHO/ECEH	WHO European Centre for Environment and Health
WMO	World Meteorological Organization

1 INTRODUCTION

The WHO Regional Office for Europe recommends comprehensive quality assurance and quality control (QA/QC) programmes on a national and international level to ensure that measurements are accurate, reliable and fit for the intended purpose (WHO 1999). Aims of QA/QC and respective definitions aside with strategies for the monitoring of air pollutants and requirements for the design and operation of air quality monitoring networks can be found in this comprehensive monograph.

A WHO consultation (WHO 1997) organised by WHO/ECEH aimed to identify and select concentration-based health-related environment indicators for ambient air quality to be used in health impact assessment (HIA). In order to specify and harmonise the data collection on ambient air quality, the main topics were:

- Data availability
- Indicator types
- Data quality and comparability
- Requirements for air quality indicators
- Methods for exposure assessment and HIA.

In 1999, WHO/ECEH initiated the programme Health Impact Assessment of Air Pollution in the WHO European Region, which aims at evaluating the capacities of Member States to monitor and assess the health impact of air pollution at local or national level. This programme will provide a comprehensive overview of the magnitude and geographical distribution of air pollution exposures and their health impact in the major urban centres and agglomerations across the European region. The approach is to use existing data from different sources of national, regional and local networks as well as databases like AIRBASE, the air quality database set up by the European Topic Centre on Air Quality of the European Environmental Agency (Xhillari and Mücke 2000).

The HIA programme is facilitated with a software package called AirQ, which has been developed by WHO/ECEH. It helps to assess the potential impact on human health of exposure to a given air pollutant in a defined urban area during a certain time period. The impact of a pollutant on human health is considered in terms of health outcomes, mortality (e.g. total, cardiovascular or respiratory mortality) and morbidity (e.g. hospital admissions for respiratory diseases, hospital admissions for cardiovascular diseases, acute bronchitis). The quantification of the health impact due to the exposure to an air pollutant is based on the concept of the population attributable risk proportion.

In 1995, the WHO Collaborating Centre for Air Quality Management and Air Pollution Control (WHO CC) at the German Federal Environmental Agency, Berlin, compiled a survey of national, regional and local air monitoring networks in 11 Member States of the WHO European Region. The survey covered the WHO Member States that participated in two intercomparison workshops held by WHO CC in 1994. It collected information on the policies and legislation on air pollution prevention and the scope of 70 different air quality monitoring networks, including the description of the measurement stations, measurement methods and devices (Mücke and Turowski 1995).

The main objective of the report on hand is to describe the current status of and QA/QC activities in 13 air quality monitoring networks in those 11 WHO Member States, which participated in intercomparison workshops on air quality monitoring conducted by WHO CC in May 1999 (Mücke et al. 2000).

A second objective is to evaluate the design and QA/QC programme of these networks in relation to the requirements for HIA according to WHO (1999).

The overall aim is to support the harmonisation process in air quality monitoring within the WHO European Region, especially for Central and Eastern countries and for the accession countries to the European Union.

Figure 1 shows the geographical location of the surveyed countries of the WHO European Region: Albania, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Russian Federation, Slovenia and Uzbekistan.

Figure 1: Geographical Location of the Surveyed Countries

2 METHODS OF SURVEILLANCE

All participants of the two European Intercomparison Workshops on Air Quality Monitoring conducted by WHO CC in May 1999 received a questionnaire, which comprised 20 questions about their air quality monitoring networks and quality assurance and quality control (QA/QC) activities.

The questionnaires asked for information in the following fields:

- Network name and legal basis (operating level, objectives)
- Monitoring sites (information on stations, measured pollutants and measurement methods)
- QA/QC activities (site visit functions, audits and intercalibrations, validity of station, validity of data)
- Data management and report of data

For a complete questionnaire, see Annex 1.

Please note that this survey does not claim completeness. In the countries that participated in this survey, there may well exist several networks in parallel, not all of which were considered here.

The participants responded only to the network or part of the network they were responsible for. In order to improve the quality of answers, the participants were involved in the review process of the entries in the presented tables. This stage ended in March 2000. Therefore, the entries should reflect the situation of the networks in 1999, unless stated otherwise.

3 RESULTS

The description of results mainly consists of tables which are listed alphabetically by acronyms of the participating countries.

3.1 Networks

A general overview of the air quality monitoring networks and their monitoring objectives are presented in the Tables 1 to 4.

Table 1 introduces the country acronyms and lists the names of the corresponding 13 air quality monitoring networks. Annex 2 gives the name of the respective network, the unit, which operates and manages the network and the complete contact address.

From Table 2 one can see that the air quality monitoring networks of all participants operate at the national level, whereas no tasks at the regional (i.e. within one country) and at the local scale are covered, except Croatia (HR).

Table 1: Country, Acronym and Name of Network

Country Acronym	Country	Full Name of Network
AL	Albania	—
BG	Bulgaria	National Air Monitoring Network
CZ 1	Czech Republic	Hygienic Service
CZ 2	Czech Republic	National Air Monitoring Network
EST 1	Estonia	Tallinn
EST 2	Estonia	UN/ECE EMEP and Integrated Monitoring
H	Hungary	PHARE Monitoring Network
HR	Croatia	—
LT	Lithuania	National Air Quality Monitoring Network
LV	Latvia	Latvian Air Quality Monitoring Network (including regional EMEP/GAW stations)
RUS	Russia	—
SLO	Slovenia	National Air Quality Monitoring Network (EU, regional EMEP/GAW stations)
UZB	Uzbekistan	—

Table 2: Operating Level of the Air Quality Monitoring Network

Air Quality Monitoring Network			
Country	National	Regional	Local
AL	✔		
BG	✔		
CZ 1	✔		
CZ 2	✔		
EST 1	✔		
EST 2	✔		
H	✔		
HR	✔		✔ [1]
LT	✔		
LV	✔		
RUS	✔		
SLO	✔		
UZB	✔		

[1] by contract through local authorities

Table 3 shows that about one half of the networks are in the responsibility of the Ministries of Environment, and about one third belong to the Ministries of Health. The Russian Rosgidromet, the Uzbek Glavgidromet and the Institute of Hydrology and Meteorology of Bulgaria carry out monitoring on behalf of decisions of the Minister's Council.

Various monitoring objectives can be distinguished from Table 4, corresponding to the allocation of the air quality monitoring networks, either to environmental or health-related objectives. In general, tasks directing towards environmental protection are covered by networks belonging to the Ministries of Environment. In the course of participations of Central and Eastern European countries in the PHARE programmes, the objective "Population exposure and health impact assessment" has been fostered by networks that do not belong to the Ministries of Health.

Table 3: Allocation of the Air Quality Monitoring Network

Network Belongs to			
Country	Ministry of Health	Ministry of Environment	Others
AL			Academy of Science
BG	✔ [1]	✔ [2]	Nat. Inst. of Hydrology and Meteorology [3]
CZ 1	✔		
CZ 2		✔	
EST 1		✔	
EST 2		✔	
H	✔		
HR	✔		
LT		✔	
LV		✔	
RUS			Rosgidromet
SLO		✔	
UZB			Glavgidromet

[1] responsible for 42 stations
[2] coordinator of network (see Mücke and Turowski (eds.) 1995, p 88), responsible for 58 stations
[3] responsible for 6 stations

Table 4: Monitoring Objectives

Monitoring Objectives													
	AL	BG	CZ 1	CZ 2	EST 1	EST 2	H	HR	LT	LV	RUS	SLO	UZB
Population exposure and HIA	✓	✓ [1]	✓	✓			✓	✓	✓	✓	✓	✓	
Identifying threats to natural ecosystems		✓ [2,3]		✓		✓				✓	✓	✓	✓
Determining compliance with national / international standards		✓ [1,2]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Informing the public about air quality (...)	✓	✓ [2]	✓	✓	✓		✓	✓	✓	✓	✓	✓	
Providing (…) inputs to air quality management (...)	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
Source identification / apportionment		✓ [2]		✓			✓	✓	✓	✓		✓	
Policy development and setting of priorities for management actions		✓ [1,2]	✓						✓	✓	✓	✓	
Development / validation of management tools (...)		✓ [1]	✓					✓	✓	✓		✓	
Trend quantification (...)		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓

[1] Ministry of Health
[2] Ministry of the Environment
[3] Institute of Hydrology and Meteorology

3.2 Monitoring Sites and Measurement Methods

The Tables 5 to 7 contain information on monitoring sites and measurement methods.

Table 5 gives the site classifications and the total number of monitoring stations. Some overlap between the sites "City/urban centre" and "Urban background" may occur, especially for RUS and UZB.

Table 5: Site Classifications and Total Number of Monitoring Stations

Total Number of Monitoring Stations in the Network and Site Classifications								
Country	City/ urban centre	Urban back-ground	Suburban/ residential	Kerbside/ near road	Industrial	Rural	Other	Total number
AL		1						1
BG	90		3		9	4		106
CZ 1	18	17	70	25	10			140
CZ 2	38	20	25		7	78		168 [1]
EST 1	1	1	1					3
EST 2						3		3 [2]
H	9	4	1				7 [3]	21
HR	15	5	6	10	15	19		70
LT	10	5	1	5	5			26
LV		7		2		2		11
RUS [4]		228	22	175	202			627
SLO	4	1		2 [5]		4	1 [6]	12
UZB [4]		19		20	30	3		72 [7]

[1] data from 1997
[2] two stations belong to EMEP, two stations belong to Integrated Monitoring, i.e. one station is used for both networks
[3] 5 mobile stations and 2 stations not included in the PHARE Monitoring Network
[4] classifications used in Russia and Uzbekistan are not fully in accordance with above criteria
[5] urban centre and near road
[6] mobile station
[7] including 3 rural stations which are not regularly operated

According to the size of a country and the covered tasks, the total number of stations of the networks vary considerably. The smallest network in the frame of our survey is the network of AL, which consists of only one station. Definitions of the site classifications can be found in our questionnaire (see Annex 1). They are in line with definitions from WHO (1999).

In many countries surveyed, selected network stations and their air quality data are used for international air monitoring programmes. Some or all of the rural stations of EST 2, HR, LV and SLO belong to EMEP (Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe) of UN/ECE. Also, the GAW (Global Atmosphere Watch) programme of WMO receives data from rural stations of SLO. The EUROAIRNET (European Air Quality Monitoring and Information Network) of the European Environment Agency receives data from stations of BG, CZ 2, LT, LV and SLO.

Table 6 shows the allocation of the measured pollutants CO, SO_2, NO, NO_2, O_3, BTX, TSP and PM_{10} to sites, which are classified according to Table 5. The table is partitioned for each component. Additional components, e.g. heavy metals, black smoke, which are also measured in many networks were not subject of this survey.

Table 6: Measurement of Pollutants, Number of Stations and Site Classifications

Measurement of CO - Number of Stations and Site Classifications								
Country	City/ urban centre	Urban back-ground	Suburban/ residential	Kerbside/ near road	Industrial	Rural	Other	Share of total number (%)
AL								0
BG	3							3
CZ 1	5		4	2				8
CZ 2	19	4	2		7	4		21
EST 1	1							33
EST 2								0
H	9	2	1				7 [1]	90
HR								0
LT	1	2		3				23
LV								0
RUS [2]		199	22	159	182			90
SLO	1			1 [3]			1 [4]	25
UZB [2]		15		12	25	3		76

[1] 5 mobile stations and 2 stations not included in the PHARE Monitoring Network
[2] classifications used in Russia and Uzbekistan are not fully in accordance with above criteria
[3] urban centre and near road
[4] mobile station

Table 6 - continued

Measurement of SO_2 - Number of Stations and Site Classifications								
Country	City/ urban centre	Urban back-ground	Suburban/ residential	Kerbside/ near road	Industrial	Rural	Other	Share of total number (%)
AL		1						100
BG	86		3		7	4		94
CZ 1	18	17	63	25	10			95
CZ 2	36	18	24		7	78		97
EST 1	1	1	1					100
EST 2						3		100
H	9	4	1				7 [1]	100
HR	15	5	6	10	15	7		83
LT	10	5	1	5	5			100
LV		7		2		2		100
RUS [2]		228	22	175	202			100
SLO	4	1		2 [3]		1	1 [4]	75
UZB [2]		19		20	30	3		100

[1] 5 mobile stations and 2 stations not included in the PHARE Monitoring Network
[2] classifications used in Russia and Uzbekistan are not fully in accordance with above criteria
[3] urban centre and near road
[4] mobile station

Table 6 - continued

Measurement of NO - Number of Stations and Site Classifications								
Country	City/ urban centre	Urban back-ground	Suburban/ residential	Kerbside/ near road	Industrial	Rural	Other	Share of total number (%)
AL								0
BG	8		3		7			17
CZ 1	5		12	3				14
CZ 2	32	9	14		7	31		55
EST 1	1		1					67
EST 2						2		67
H	9	4	1				7 [1]	100
HR			1					1
LT	2	1		2	1			23
LV								0
RUS [2]		56	8	45	51			26
SLO	3			1 [3]			1 [4]	42
UZB [2]		5		5	10			28

[1] 5 mobile stations and 2 stations not included in the PHARE Monitoring Network
[2] classifications used in Russia and Uzbekistan are not fully in accordance with above criteria
[3] urban centre and near road
[4] mobile station

Table 6 - continued

Measurement of NO_2 - Number of Stations and Site Classifications								
Country	City/ urban centre	Urban back-ground	Suburban/ residential	Kerbside/ near road	Industrial	Rural	Other	Share of total number (%)
AL								0
BG	86		3		7	4		94
CZ 1	5		12	3				14
CZ 2	32	10	16		7	34		59
EST 1	1	1 [1]	1					100
EST 2						3		100
H	9	4	1				7 [2]	100
HR	6		10	2	5	12		50
LT	10	5	1	5	5			100
LV		7		2		2		100
RUS [3]		228	22	175	202			100
SLO	3			1 [4]			1 [5]	42
UZB [3]		19		20	30	3		100

[1] until end of 1998
[2] 5 mobile stations and 2 stations not included in the PHARE Monitoring Network
[3] classifications used in Russia and Uzbekistan are not fully in accordance with above criteria
[4] urban centre and near road
[5] mobile station

Table 6 - continued

Measurement of O_3 - Number of Stations and Site Classifications								
Country	City/ urban centre	Urban back-ground	Suburban/ residential	Kerbside/ near road	Industrial	Rural	Other	Share of total number (%)
AL								0
BG	6							6
CZ 1	2	1	6	2				8
CZ 2	4	5	2		7	17		21
EST 1	1							33
EST 2						3		100
H	6	4	1				7 [1]	86
HR	1		1	1				4
LT				1				4
LV		7		2 [2]		1 [3]		91
RUS								0
SLO	3	1		2 [2]		3	1 [3]	83
UZB [4]		3		3	10			22

[1] 5 mobile stations and 2 stations not included in the PHARE Monitoring Network
[2] urban centre and near road
[3] mobile station
[4] classifications used in Uzbekistan are not fully in accordance with above criteria

Table 6 - continued

Measurement of BTX - Number of Stations and Site Classifications								
Country	City/ urban centre	Urban back-ground	Suburban/ residential	Kerbside/ near road	Industrial	Rural	Other	Share of total number (%)
AL								0
BG	5				3			8
CZ 1								0
CZ 2	1	1			2	1		3
EST 1								0
EST 2								0
H								0
HR								0
LT								0
LV								0
RUS [1]		23	20		20			10
SLO	1						1 [2]	17
UZB								0

[1] classifications used in Russia are not fully in accordance with above criteria
[2] mobile station

Table 6 - continued

Measurement of TSP - Number of Stations and Site Classifications								
Country	City/ urban centre	Urban back-ground	Suburban/ residential	Kerbside/ near road	Industrial	Rural	Other	Share of total number (%)
AL								0
BG	90				7			92
CZ 1	18		66	15	10			78
CZ 2	3	7	7		5	43		39
EST 1	1							33
EST 2								0
H								0
HR	3		1	2				9
LT	9	5	1	3	5			88
LV								0
RUS [1]		217		173	198			94
SLO	1							8
UZB [1]		19		12		3		47

[1] classifications used in Russia and Uzbekistan are not fully in accordance with above criteria

Table 6 - continued

Measurement of PM_{10} - Number of Stations and Site Classifications								
Country	City/ urban centre	Urban back-ground	Suburban/ residential	Kerbside/ near road	Industrial	Rural	Other	Share of total number (%)
AL								0
BG	4							4
CZ 1	4		12	3				14
CZ 2	32	9	14		7	31		55
EST 1								0
EST 2								0
H	9	2					4 [1]	71
HR			1					1
LT	1							4
LV								0
RUS								0
SLO	3						1 [2]	33
UZB								0

[1] 3 mobile stations and 1 station not included in the PHARE Monitoring Network
[2] mobile station

Table 6 shows that CO is included into the regular measurement programme of most networks, but - except H, RUS and UZB - the share of all stations of a network, which measure CO, is equal or below 33%.

In many networks, the components SO_2 and NO_2 are of particular interest. More than 75% of stations of these networks are equipped with SO_2 measurement devices, and 50% or more measure NO_2 (except AL, CZ 1 and SLO).

The component NO is monitored mainly at stations which are equipped with automatic methods (see Table 7). This explains the fact that the number of stations measuring NO is smaller than the number of those for NO_2, which is measured by both automatic and manual methods.

Relatively little attention is paid to the measurement of O_3, hence only EST 2, H, LV and SLO measure O_3 to a share of more than 50% of stations of their networks.

Aromatic compounds like benzene, toluene and xylenes (BTX) are increasingly included into air monitoring programmes, but until now they are measured regularly only in four networks.

Compared to the toxicological relevance of TSP and PM_{10}, these components are measured to a little extent. Only the networks of BG, CZ 1, LT and RUS are equipped with TSP measurement devices in more than 50% of stations of their networks. The component PM_{10} is monitored to a share of more than 50% only by CZ 2 and H. In the latter network, the monitoring of TSP is entirely substituted for PM_{10}. In the network of CZ 2, the measurement of PM_{10} is predominant in urban areas, while the measurement of TSP is still important for rural areas.

Information on the applied measurement method (automatic or manual, i.e. carried out with samplers or filters), the minimum averaging time (duration) of a measurement, i.e. the sampling interval or integration period, the times and the week days of measurement for each pollutant in question can be drawn from Table 7.

Table 7: Measurement Method, Minimum Averaging Time (Duration) and Frequency of Measurement

Measurement Method, Minimum Averaging Time (Duration) and Frequency of Measurement							
		CO			SO_2		
		Duration	Frequency		Duration	Frequency	
Country	Measure-ment method		Times of measure-ment	Days of measure-ment		Times of measure-ment	Days of measure-ment
AL	a m				30 min	8:00 - 16:00	1 - 5
BG	a m	3 - 5 min	cont	1 - 7	3 - 5 min 30 min	cont 8:00 11:30 13:30 16:00	1 - 7 1 - 5
CZ 1	a m	30 min	cont	1 - 7	30 min 24 hours	cont 7:00 - 7:00	1 - 7 1 - 5 or 1 - 7
CZ 2	a m	30 min [1]	cont	1 - 7	30 min [1]	cont	1 - 7
EST 1	a m	5 min	cont	1 - 7	5 min	cont	1 - 7
EST 2	a m				10 min 24 hours	cont 8:00 - 8:00	1 - 7 1 - 7
H	a m	15 min [2]	cont	1 - 7	15 min [2]	cont	1 - 7
HR	a m				15 min 24 hours	cont 12:00 - 12:00	1 - 7 1 - 7
LT	a m	30 min 30 min	cont 7:00 13:00 19:00	1 - 7 1 - 6	30 min 30 min	cont 7:00 13:00 19:00	1 - 7 1 - 6
LV	a m				1 - 2 min 24 hours	cont 9:00 - 9:00	1 - 7 1 - 7
RUS	a m	 20 min [3]	 7:00 13:00 19:00	 1 - 5 or 1 - 6	 20 min	 7:00 13:00 19:00	
SLO	a m	30 min	cont	1 - 7	30 min	cont	1 - 7
UZB	a m	 2 min [3]	 7:00 13:00 19:00	 1 - 6	 20 min	 7:00 13:00 19:00	 1 - 6

a automatic measurement, m manual measurement, cont continuously, min minute
1 Monday, 5 Friday, 6 Saturday, 7 Sunday

[1] from 3 to 5 s integration intervals [2] from 1 to 2 min integr. intervals [3] semi-autom. method

Table 7 - continued

Measurement Method, Minimum Averaging Time (Duration) and Frequency of Measurement							
		NO			NO_2		
		Duration	Frequency		Duration	Frequency	
Country	Measure-ment method		Times of measure-ment	Days of measure-ment		Times of measure-ment	Days of measure-ment
AL	a m						
BG	a m	3 - 5 min 30 min	cont 8:00 11:30 13:30 16:00	1 - 7 1 - 5	3-5 min 30 min	cont 8:00 11:30 13:30 16:00	1 - 7 1 - 5
CZ 1	a m	30 min	cont	1 - 7	30 min	cont	1 - 7
CZ 2	a m	30 min [1]	cont	1 - 7	30 min [1]	cont	1 - 7
EST 1	a m	5 min	cont	1 - 7	5 min	cont	1 - 7
EST 2	a m	10 min	cont	1 - 7	10 min 24 hours	cont 8:00 - 8:00	1 - 7 1 - 7
H	a m	15 min [2]	cont	1 - 7	15 min [2]	cont	1 - 7
HR	a m	15 min	cont	1 - 7	15 min 24 hours	cont 12:00 - 12:00	1 - 7 1 - 7
LT	a m	30 min 30 min	cont 7:00 13:00 19:00	1 - 7 1 - 6	30 min 30 min	cont 7:00 13:00 19:00	1 - 7 1 - 6
LV	a m				1 - 2 min 24 hours	cont 9:00 - 9:00	1 - 7 1 - 7
RUS	a m	 20 min	 7:00 13:00 19:00	 1 - 5 or 1 - 6	 20 min	 7:00 13:00 19:00	 1 - 5 or 1 - 6
SLO	a m	30 min	cont	1 - 7	30 min	cont	1 - 7
UZB	a m	 20 min	 7:00 13:00 19:00	 1 - 6	 20 min	 7:00 13:00 19:00	 1 - 6

a automatic measurement, m manual measurement, cont continuously, min minute

1 Monday, 5 Friday, 6 Saturday, 7 Sunday

[1] from 3 to 5 s integration intervals

[2] from 1 to 2 min integration intervals

Table 7 - continued

Measurement Method, Minimum Averaging Time (Duration) and Frequency of Measurement							
		O_3			BTX		
		Duration	Frequency		Duration	Frequency	
Country	Measure-ment method		Times of measure-ment	Days of measure-ment		Times of measure-ment	Days of measure-ment
AL	a m						
BG	a m	3 - 5 min 30 min	cont 8:00 11:30 13:30 16:00	1 - 7 1 - 5	3 - 5 min 60 min	cont 8:00 11:30 13:30 16:00	1 - 7 1 - 5
CZ 1	a m	30 min	cont	1 - 7			
CZ 2	a m	30 min [1]	cont	1 - 7	30 min	cont	1 - 7
EST 1	a m	5 min	cont	1 - 7			
EST 2	a m	10 min	cont	1 - 7			
H	a m	15 min [2]	cont	1 - 7			
HR	a m	15 min 24 hours	cont 12:00 - 12:00	1 - 7 1 - 7			
LT	a m	30 min	cont	1 - 7			
LV	a m	1 - 2 min	cont	1 - 7			
RUS	a m				20 min	7:00 13:00 19:00	1 - 5 or 1 - 6
SLO	a m	30 min	cont	1 - 7	2 x 13.5 min	cont	1 - 7
UZB	a m	20 min	7:00 13:00 19:00	1 - 6			

a automatic measurement, m manual measurement, cont continuously, min minute

1 Monday, 5 Friday, 6 Saturday, 7 Sunday

[1] from 3 to 5 s integration intervals
[2] from 1 to 2 min integration intervals

Table 7 - continued

Measurement Method, Minimum Averaging Time (Duration) and Frequency of Measurement							
		TSP			PM$_{10}$		
		Duration	Frequency		Duration	Frequency	
Country	Measure- ment method		Times of measure- ment	Days of measure- ment		Times of measure- ment	Days of measure- ment
AL	a m						
BG	a m	24 hours 24 hours	cont 9:00 - 9:00	1 - 7 1 - 5	24 hours	9:00 - 9:00	1 - 5
CZ 1	a m	24 hours	7:00 - 7:00	1 - 5 or 1 - 7	30 min	cont	1 - 7
CZ 2	a m	24 hours	7:00 - 7:00	1 - 7	30 min	cont	1 - 7
EST 1	a m	24 hours	0:00 - 0:00	every 3rd day			
EST 2	a m						
H	a m				30 min	cont	1 - 7
HR	a m	24 hours	12:00 - 12:00	1 - 7	24 hours	12:00 - 12:00	1 - 7
LT	a m	30 min	7:00 13:00 19:00	1 - 6	30 min	cont	1 - 7
LV	a m						
RUS	a m	20 min	7:00 13:00 19:00	1 - 5 or 1 - 6			
SLO	a m	30 min	cont	1 - 7	30 min	cont	1 - 7
UZB	a m	20 min	7:00 13:00 19:00	1 - 6			

a automatic measurement, m manual measurement, cont continuously, min minute

1 Monday, 5 Friday, 6 Saturday, 7 Sunday

The network of AL, H and SLO use automatic methods solely. With the exception of TSP measurement, EST 1 is also an automatic network. The network of AL measures only the component SO_2.

In most networks automatic methods are in use, especially for the components CO, SO_2 , NO, NO_2 and O_3. But manual methods still play an important role for these components. For a measured component, manual methods are often used besides automatic methods within the networks of BG, EST 2, HR, LT and LV.

In RUS and UZB all the measurements are performed by manual sampling three times a day and wet-chemical analysis, except for CO.

The network of BG is mainly a manual one, supplemented with six differential optical analysis system devices. Sampling with manual methods is carried out four times a day.

The column "Duration" in Table 7 shows for the automatic analysers that different integration intervals are in use. As a consequence, the amount of data to be handled varies considerably. When comparing the minimum averaging time (sampling time) for the manual methods within the networks one can see big differences, especially for NO_2, SO_2, O_3 and TSP. This fact can be explained by different objectives of measurements, e.g. long-range transport of pollutants at a low concentration level vs. population exposure assessment with higher concentrations expected.

Column "Days of Measurement" shows that with automatic methods the coverage of days of measurement is complete (except AL). When manual methods are applied and the sampling time is shorter than 24 hours, the days of measurement are limited to Monday until Friday or Saturday.

3.3 Quality Assurance and Control (QA/QC)

Tables 8 to 13 contain information on regular QA/QC activities, e.g. site visit functions and responsibilities, audits and intercalibrations, and data management measures, e.g. data validation procedures and check of completeness of data. More detailed information on strategies for the implementation of QA/QC activities can be found in WHO (1999).

Table 8 gives the frequency of regular on-site operations concerning QA/QC activities as routine site visits. These tasks are applicable for both manual methods and automatic methods. Nevertheless, each network design requires additional on-site operations, which are specific for the methods applied for analysis and for the network.

Table 8: Regular QA/QC Operations: Site Visit Functions

Regular On-site QA/QC System Operations	Frequency					
	AL	BG [1]	CZ 1 [2]	CZ 2	EST 1	EST 2
Ensure smooth running of equipment	1/d	–	1/w	1/w 1/m	1/d	1/m
Calibration and diagnostic checks	1/m	1/d 1/m	1/m [3] 4/y [3]	1/w 1/m	1/m	1/m
Anticipating future problems	–	–	1/m	1/m	1/m	1/m
Change of filters and consumables	1/m [4]	1/d 1/w 1/m	1/m	1/w 1/m	2/m	1/m
Check sampling systems and pumps	–	1/m	4/y [3]	1/w 1/m	1/w	1/m
Cleaning of sampling system	–	1/m	1/m	1/w 1/m	2/y	2/y
Install/replace/repair equipment	–	1/d 1/w 1/m	–	1/w 1/m	1/m	1/m
Check external site conditions	–	1/m	–	1/m	1/y	1/y

d day, w week, m month, y year

[1] only for stations of Ministry of Health
[2] only for automatic stations
[3] by external control
[4] if necessary

Table 8 - continued

Regular On-site QA/QC System Operations	Frequency						
	H	HR	LT	LV	RUS	SLO	UZB
Ensure smooth running of equipment	1/w	1/d	1/d	1/m [5] 1/d [6]	1/d [2]	1/d [7]	1/d
Calibration and diagnostic checks	1/w	2/m	1/m	1/y [6] 3/m [6]	1/m	1/d [7]	1/m
Anticipating future problems	1/m	–	1/m	1/m [6]	–	–	–
Change of filters and consumables	2/m	1/d	1/d	1/w [5]	1/m	1/w 1/m	1/m
Check sampling systems and pumps	1/m	1/m	1/d	1/m [5] 4/y [6]	1/m	1/m	1/m
Cleaning of sampling system	1/m	1/m	1/m	1/m [5] 2/y [6]	1/m	1/m	1/m
Install/replace/repair equipment	1/m	–	–	1/m [5] 4/y [6]	1/w	1/d [4]	–
Check external site conditions	1/m	1/d	–	–	1/y	1/m	1/y

d day, w week, m month, y year

[4] if necessary
[5] only for manual stations
[6] only for automatic stations
[7] function control at intervals of 24.5 hours

In all networks, regular site visits are part of their QA/QC system. The frequency of the on-site operations differs between the networks and within the networks from daily to monthly, in some cases up to yearly checks, depending on the measurement methods applied.

In many networks, the central laboratories have delegated or outsourced part of the on-site operations (Table 8) to subordinated branches and laboratories, or to external organisations, respectively, by means of subcontracts. This structure is shown in Table 9.

Table 9: Responsibility for the Conduction of On-site Operations

On-site Operations Are Carried out by:			
Country	Central laboratory of Network operator	Subordinated branches / laboratories	External organisations
AL	✔		
BG	✔	✔	✔ [1]
CZ 1	✔	✔	✔
CZ 2	✔	✔	✔
EST 1	✔		
EST 2	✔		
H		✔	✔
HR	✔		
LT		✔	
LV	✔		
RUS	✔	✔	
SLO	✔		
UZB	✔		✔ [2]

[1] by Committee of Standardisation and Metrology
[2] concerning the check of external site conditions

Some QA/QC operations like regular audits and intercalibrations, which concern the whole network, are presented in Table 10. These audits consist in a qualitative and systematic assessment of operator procedures, site performances, infrastructure and instrumentation. Intercalibrations within a network allow a quantitative assessment of the measurement system at each site to analyse the consistency of methods and results.

Table 10: Regular QA/QC Operations: Audits and Intercalibrations

Audits and Intercalibrations of Network	**Frequency**					
	AL	BG	CZ 1	CZ 2	EST 1	EST 2
Ensure data comparability	–	1/m	1/m	1/m	1/m	4/y
Check site conditions/ anomalies	–	2/y	1/y	1/m	1/y	1/y
Check consistency of site operations	–	1/m	1/y	1/m	1/y	1/y
Investigate systematic measurement anomalies	–	2/y	1/m	1/m	1/y	1/y
Conducting intercalibrations	–	1/y	1-4/y	1/m	–	–

m month, y year

Table 10 - continued

Audits and Intercalibrations of Network	**Frequency**						
	H	HR [1]	LT	LV	RUS	SLO	UZB
Ensure data comparability	1/m	1/m	1/m	–	0.2/y	2/y [2] 4/y [3]	2/y
Check site conditions/ anomalies	4/y	1/m	–	4/y	4/y	1/m	–
Check consistency of site operations	1/m	1/m	1/m	1/y	1/y	1/m	–
Investigate systematic measurement anomalies	1/m	1/m	–	1/y	–	1/m	–
Conducting intercalibrations	–	1/y	2/y	–	1/y	3/y	–

m month, y year

[1] entries apply to manual stations only, frequency is higher for automatic stations
[2] SO_2, CO, NO_x
[3] O_3

One finding is that, with the exception of SLO, small networks like AL, EST 1, EST 2 and LV conduct audits and intercalibrations to a smaller extent compared to larger networks. In general, little attention is paid to regular intercalibrations within a network, as only some 50% of all networks conduct intercalibrations at all, and only about one third of all networks conduct intercalibrations more than once a year.

Table 11 gives the responsibility for the performance of audits and intercalibrations as listed in Table 10.

Table 11: Responsibility for the Conduction of Audits and Intercalibrations

Audits and Intercalibrations are Carried out by:			
Country	Central laboratory of network operator	Subordinated branches / laboratories	External organisations
AL	✔ [1]		
BG	✔	✔	✔ [2]
CZ 1	✔		
CZ 2	✔	✔	
EST 1	✔ [1]		
EST 2	✔ [1]		
H	✔	✔	
HR	✔ [1]		
LT	✔	✔	
LV	✔ [1]		✔
RUS	✔	✔	
SLO	✔		
UZB	✔	✔	

[1] no subordinated branch within network
[2] by Committee of Standardisation and Metrology

More than it is the case for on-site operations (Table 9), some or all of these network operations are carried out by the central laboratories themselves, often with involvement of their subordinated branches or laboratories.

The existence of training components for subordinated branches and laboratories was inquired and compiled in Table 12.

Table 12: Training Courses for Subordinated Branches and Laboratories

Training Courses Conducted by Central Laboratory of Network Operator	
Country	Days per year
AL	0 [1]
BG	5 - 10
CZ 1	2 - 4
CZ 2	2 x 2 [2]
EST 1	0 [1]
EST 2	0 [1]
H	2
HR	0 [1]
LT	5
LV	0 [1]
RUS	5 [3]
SLO	5
UZB	0 [3]

[1] no subordinated branch within network
[2] additionally 2 to 3 visits
[3] not in 1999 (for financial reasons)

In general, when subordinated branches are part of the network structure, training courses are part of the QA/QC activities of the networks (Table 12). For economic problems, these courses did not take place in 1999 in the case of RUS and UZB.

As WHO CC had conducted nine intercomparison workshops between 1994 and 1999, WHO CC and the WHO European Centre for Environment and Health, Bilthoven Division, were interested to receive a feedback concerning implementations of QA/QC measures resulting from previous workshop participations. The answers from the networks surveyed are listed in Table 13.

Table 13: Implementations of QA/QC in the Network Resulting from Previous Participations in WHO Intercomparison Workshops

Implementations of QA/QC	
Country	
AL	none
BG	change of sampling pumps, check of absorption solutions, calibration lines, flow rate before and after sampling and blanks
CZ 1	intercomparison workshop of mobile measuring systems and interlaboratory testing
CZ 2	check of stability of gas mixtures and co-operation (technical) with UBA Pilotstation
EST 1	none [1]
EST 2	none [1]
H	check of calibration systems
HR	none
LT	none
LV	none [2]
RUS	external control by mailing of control samples (now interrupted for financial difficulties); comparisons of the standard methods and devices
SLO	comparison of measurements, comparison of standards and measurement devices from Hydrometeorological Institute with those of regional and local networks
UZB	none

[1] In 1999, the Estonian Environmental Research Centre participated for the first time in a WHO Intercomparison Workshop.
[2] In 1999, the Latvian Hydrometeorological Agency participated for the first time in a WHO Intercomparison Workshop.

It can be derived from many of the participants' statements that intercomparison workshops of WHO CC play an important role in their QA/QC management systems.

3.4 Data Management and Report

Before raw data are turned into "useful information" they have to be evaluated by a proper data management system. This system consists of data validation procedures and a so called data ratification process, where information on methods, site characteristics, audits and intercalibrations etc. is judged by experts. Tables 14 to 18 refer to the data management and reporting system.

Table 14 presents the data validation procedures that are applied in the networks. All data are reviewed and listings and graphs are used in almost all networks.

Table 14: Data Validation Procedures

Data Validation Procedures			
Country	Review of all Data	Use of Listings and Graphs	Others
AL	✔	✔	
BG	✔	✔	
CZ 1	✔	✔	Shewart diagrams
CZ 2	✔	✔	statistical
EST 1	✔	✔	
EST 2	✔	✔	
H	✔	✔	statistical
HR	✔	✔	statistical
LT	✔	✔	
LV	✔		
RUS	✔	✔	statistical
SLO	✔	✔	
UZB	✔	✔	

Parameters like accuracy (i.e. deviation of a single value from the "true" value) and precision (i.e. distribution of random errors, measured as standard deviation in a series of test results) are used as indicators for the data quality of an analytical method used in a network. The criteria, which have to be met in the networks in relation to the methods applied, are listed in Table 15.

The criteria for accuracy and precision of data range between 3 to 25% among the networks. In three networks no requirements for the quality of data are defined. The networks EST 2 and LV use the data quality indicator "uncertainty" (i.e. combined accuracy and precision for sampling and analysis) from the EMEP programme, which is 15 to 25%.

Table 15: Accuracy and Precision of Data

Accuracy and Precision of Data				
Country	Measurement Method	Accuracy (+/- %)	Precision (+/- %)	Other Requirements
AL[1]	a m			
BG	a m	10 25	10 25	
CZ 1	a m	5 [2] 10 [2]	5 [2] 10 [2]	 TSP: max. deviation 10% of parallel measurements
CZ 2	a m	10 [2] 10 [2]	10 [2] 10 [2]	
EST 1 [1, 3]	a m			
EST 2	a m	– –	– –	 uncertainty 15 - 20%
H[1]	a m			
HR	a m	10 10	5 5	
LT	a m	– 5 - 25 [4]	– 5 - 25	
LV	a m	5 –	3 - 5 –	 uncertainty 15 - 25% [5]
RUS	a m	– –	– –	 uncertainty 10 - 25% [6]
SLO	a m	5 - 10 5 - 10	5 - 10 5 - 10	
UZB	a m	– –	– –	 uncertainty 10 - 25% [6]

a automatic measurement, m manual measurement
1 Monday, 5 Friday, 6 Saturday, 7 Sunday

[1] no criteria defined
[2] standard deviation
[3] criteria in approvement process
[4] manual methods of LT:

CO	NO	NO_2	SO_2	TSP
5	25	18	12	25

[5] only for manual methods
[6] methods of RUS and UZB:

CO	NO	NO_2	SO_2	TSP	O_3
25	25	25	25	25	10

Table 16 gives information on national standard criteria for capture rates for pollutants measured. The capture rate, which is another indicator for data quality, is defined as the percentage of measurements at a certain station, which are judged to be valid measurement within a set time.

Table 16: Capture Rates Used as National Criteria for the Validity of a Station

Data Capture (%)										
	CO					SO_2				
Country	30 min av	1 h av	8 h av	24 h av	annual av	30 min av	1 h av	8 h av	24 h av	annual av
AL[1]										
BG[1]										
CZ 1	66.7	–	–	66.7	66.7	66.7	–	–	66.7	66.7
CZ 2	–	50	75	75	66	–	50	–	75	66
EST 1	–	75	–	75	75	–	–	–	–	–
EST 2	NA	NA	NA	NA	NA	–	–	–	–	90 [2]
H	75	–	–	75	75	75	–	–	75	75
HR [1]										
LT	–	–	–	–	25 [3]	–	–	–	–	25 [3]
LV	NA	NA	NA	NA	NA	–	75	–	75	90
RUS	–	–	–	–	73 [4]	–	–	–	–	73 [4]
SLO	75	85	85	85	85	75	85	–	85	85
UZB	–	–	–	–	73 [4]	–	–	–	–	73 [4]

NA not applicable, av average, min minute, h hour

[1] no criterion defined
[2] EMEP criteria
[3] only for manual measurements, 75% used as internal criterion (for automatic measurements)
[4] 800 valid measurements (of 20 min averages)

Table 16 - continued

Data Capture (%)										
	NO					NO_2				
Country	30 min av	1 h av	8 h av	24 h av	annual av	30 min av	1 h av	8 h av	24 h av	annual av
AL[1]										
BG[1]										
CZ 1	66.7	–	–	66.7	66.7	66.7	–	–	66.7	66.7
CZ 2	–	50	–	75	66	–	50	–	75	66
EST 1	–	75	–	75	75	–	75	–	75	75
EST 2	–	75	–	75	75	–	75	–	75	75
H	75	–	–	75	75	75	–	–	75	75
HR [1]										
LT	–	–	–	–	25 [2]	–	–	–	–	25 [2]
LV	NA	NA	NA	NA	NA	–	75	–	75	90
RUS	–	–	–	–	73 [3]	–	–	–	–	73 [3]
SLO	85	85	–	85	85	75	85	–	85	85
UZB	–	–	–	–	73 [3]	–	–	–	–	73 [3]

NA not applicable, av average, min minute, h hour

[1] no criterion defined
[2] only for manual measurements, 75% used as internal criterion (for automatic measurements)
[3] 800 valid measurements (of 20 min averages)

Table 16 - continued

Data Capture (%)										
	O_3					BTX				
Country	30 min av	1 h av	8 h av	24 h av	annual av	30 min av	1 h av	8 h av	24 h av	annual av
AL[1]										
BG[1]										
CZ 1	66.7	–	66.7	66.7	66.7	NA	NA	NA	NA	NA
CZ 2	–	50	75	75	66	–	50	–	75	66
EST 1	–	–	–	–	–	NA	NA	NA	NA	NA
EST 2	–	–	–	90 [2]	90 [2]	NA	NA	NA	NA	NA
H	75	–	–	75	75	NA	NA	NA	NA	NA
HR [1]										
LT	–	–	–	–	75 [3]	NA	NA	NA	NA	NA
LV	–	75	75	75	90	NA	NA	NA	NA	NA
RUS	NA	NA	NA	NA	NA	–	–	–	–	73 [4]
SLO	75	85	85	85 (90 [5])	85 (90 [5])	75	85	–	85	85
UZB	–	–	–	–	73 [4]	NA	NA	NA	NA	NA

NA not applicable, av average, min minute, h hour

[1] no criterion defined
[2] EMEP criteria
[3] only internal criterion
[4] 800 valid measurements (of 20 min averages)
[5] EMEP and GAW stations

Table 16 - continued

Data Capture (%)										
	TSP					PM_{10}				
Country	30 min av	1 h av	8 h av	24 h av	annual av	30 min av	1 h av	8 h av	24 h av	annual av
AL[1]										
BG[1]										
CZ 1	–	–	–	66.7	66.7	66.7	–	–	66.7	66.7
CZ 2	–	50	–	75	66	–	50	–	75	66
EST 1	–	–	–	–	–	NA	NA	NA	NA	NA
EST 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
H	NA	NA	NA	NA	NA	75	–	–	75	75
HR [1]										
LT	–	–	–	–	25 [2]	–	–	–	–	75 [3]
LV	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RUS	–	–	–	–	73 [4]	NA	NA	NA	NA	NA
SLO	75	85	–	85	85	75	85	–	85	85
UZB	–	–	–	–	73 [4]	NA	NA	NA	NA	NA

NA not applicable, av average, min minute, h hour

[1] no criterion defined
[2] only for manual measurements, 75% used as internal criterion (for automatic measurements)
[3] only internal criterion
[4] 800 valid measurements (of 20 min averages)

In WHO (1999), the data completeness for the 24 hour and annual averages is recommended to be at least 50%. Additionally, the validity of a station is given for one-hour and eight-hour averages, if at least 75% of the data have been used.

When automatic methods are applied, a capture rate for the 30-minute average can be calculated, as the integration time for automatic methods lies mostly within some seconds. When manual methods are applied and three values per day are measured, a capture rate of 66.7% for the 24-hour average means that two out of three measurements have to be accepted after the data validation process, otherwise a 24-hour average cannot be calculated.

The results from Table 16 show that in three countries (AL, BG and HR) no criteria for capture rates are defined. Not applicable (NA) is entered for components which are not measured within a network.

Among the countries with automatic methods, the 75% criterion for one-hour averages is not used by CZ 1, CZ 2 and LT. The networks EST 1 and EST 2 have no criteria for the one-hour averages for SO_2 and O_3. The 50% criteria for the 24-hour and annual averages are used by all countries with automatic methods, except LT which uses a 75% criterion for the annual average as an internal criterion only.

The last step after the data validation process consists in data reporting. Table 17 shows the frequency of data reporting and Table 18 shows, which data (averages, percentiles, comparisons to guidelines or standards) are used for data reporting.

With respect to health-related effects of the pollutants monitored, a one-hour average should be reported for CO, NO_2 and O_3, additionally an eight-hour average for O_3 is needed, whereas concentrations of SO_2, TSP and PM_{10} should be given as 24-hour averages. For all pollutants, annual arithmetic means and the 98^{th} percentile should be reported (WHO 1999).

Table 17: Frequency of Data Reporting

Frequency of Data Reporting				
Country	Monthly	Every 3 Months	Every 6 Months	Annually
AL	✔			✔
BG	✔	✔	✔	✔
CZ 1	✔			✔
CZ 2	✔		✔	✔
EST 1	✔		✔	✔
EST 2			✔	✔
H			✔ [1]	
HR	✔			✔
LT	✔	✔	✔	✔
LV	✔		✔	✔
RUS	✔			✔
SLO	✔			✔
UZB	✔	✔	✔	✔

[1] divided into heating and non-heating period

Table 18: Report of Data

(Note: Bold type is used when entries differ from the original questionnaire)

AL	**Report of Data**							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
30 min. average								
1 h average		✔						
8 h average								
24 h average		✔						
Annual average								
50 percentile								
90 percentile								
95 percentile								
98 percentile of 24 h average		✔						
Exceedances of								
– national standard								
– WHO Air Quality Guidelines								

BG	**Report of Data**							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
30 min. average [1]	✔	✔	✔	✔	✔	✔		
1 h average								
8 h average								
24 h average	✔	✔	✔	✔	✔	✔	✔	✔
Annual average	✔	✔	✔	✔	✔	✔	✔	✔
50 percentile								
90 percentile								
95 percentile								
98 percentile								
Exceedances of								
– national standard	✔	✔	✔	✔	✔	✔	✔	
– WHO Air Quality Guidelines								✔
– others: EC Directive 1999/30/EC								✔

[1] only for automatic methods

Table 18 - continued

CZ 1	**Report of Data**							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
30 min. average	✔	✔ [1]	✔	✔	✔			✔
1 h average								
8 h average					✔			
24 h average	✔	✔	✔	✔	✔		✔	✔
Annual average	✔	✔	✔	✔	✔		✔	✔
50 percentile								
90 percentile								
95 percentile	✔	✔					✔	✔
98 percentile								
Exceedances of								
– national standard	✔	✔			✔		✔	
– WHO Air Quality Guidelines [2]	✔	✔	✔	✔	✔		✔	✔

[1] only for automatic methods [2] only for evaluation

CZ 2	**Report of Data**							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
max. of 30 min. average	✔	✔	✔	✔	✔	✔		✔
max. of 1 h average					✔			
8 h average	✔				✔			
max. of 24 h average	✔	✔	✔	✔	✔	✔	✔	✔
Annual average	✔	✔	✔	✔	✔	✔	✔	✔
Arithmetic and geometric mean	✔	✔	✔	✔	✔	✔	✔	✔
50 percentile	✔	✔	✔	✔	✔	✔	✔	✔
90 percentile								
95 percentile	✔	✔	✔	✔	✔	✔	✔	✔
98 percentile	✔	✔	✔	✔	✔	✔	✔	✔
Exceedances of								
– national standard	✔	✔	✔	✔	✔		✔	✔
– WHO Air Quality Guidelines								

Table 18 - continued

EST 1	Report of Data							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
30 min. average								
1 h average	✔	✔	✔	✔	✔			
8 h average								
24 h average								
Monthly average	✔	✔	✔	✔	✔		✔	
Annual average							✔	
50 percentile								
90 percentile								
95 percentile								
98 percentile								
Exceedances of								
– national standard	✔	✔	✔	✔	✔		✔	
– WHO Air Quality Guidelines								

EST 2	Report of Data							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
30 min. average								
1 h average					✔			
8 h average								
24 h average								
Monthly average		✔	✔	✔	✔			
Annual average		✔	✔	✔	✔			
50 percentile								
90 percentile								
95 percentile								
98 percentile								
Exceedances of								
– national standard					✔			
– WHO Air Quality Guidelines								

Table 18 - continued

H	**Report of Data**							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
30 min. average	✔	✔	✔	✔	✔			✔
1 h average								
8 h average								
24 h average								
6 month average	✔	✔	✔	✔	✔			✔
50 percentile								
90 percentile								
95 percentile								
98 percentile	✔	✔	✔	✔	✔			✔
Exceedances of								
– national standard	✔	✔	✔	✔	✔			✔
– WHO Air Quality Guidelines								
– others: N° of valid data	✔	✔	✔	✔	✔			✔

HR	**Report of Data**							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
30 min. average								
1 h average					✔ [1]			
8 h average								
24 h average		✔	✔	✔	✔		✔	✔
Annual average		✔	✔	✔	✔		✔	✔
50 percentile								
90 percentile								
95 percentile		✔	✔	✔	✔		✔	✔
98 percentile		✔	✔	✔	✔		✔	✔
Exceedances of								
– national standard		✔	✔	✔	✔		✔	✔
– WHO Air Quality Guidelines		✔	✔	✔	✔		✔	✔

[1] only for automatic method

Table 18 - continued

LT	Report of Data							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
30 min. average [1]	✔	✔	✔	✔	✔			✔
1 h average [1]	✔	✔	✔	✔	✔			✔
8 h average								
24 h average	✔	✔	✔	✔	✔		✔	✔
Annual average	✔	✔	✔	✔	✔		✔	✔
50 percentile								
90 percentile								
95 percentile								
98 percentile	✔	✔	✔	✔	✔			✔
Exceedances of								
– national standard	✔	✔	✔	✔	✔		✔	✔
– WHO Air Quality Guidelines								

[1] only for automatic methods

LV	Report of Data							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
30 min. average [1]		✔		✔				
1 h average [1]		✔		✔	✔			
8 h average					✔			
24 h average		✔		✔	✔			
Annual average		✔		✔	✔			
50 percentile		✔		✔	✔			
90 percentile								
95 percentile								
98 percentile		✔		✔	✔			
Exceedances of								
– national standard		✔		✔	✔			
– WHO Air Quality Guidelines		✔						

[1] only for automatic methods

Table 18 - continued

RUS	**Report of Data**							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
20 min. average [1]	✔	✔	✔	✔			✔	
1 h average								
8 h average								
24 h average								
Annual average	✔	✔	✔	✔		✔	✔	
50 percentile								
90 percentile								
95 percentile								
99 percentile	✔	✔	✔	✔		✔	✔	
Exceedances of								
– national standard	✔	✔	✔	✔		✔	✔	
– WHO Air Quality Guidelines	✔	✔	✔	✔		✔	✔	

[1] only 3 data per day

SLO	**Report of Data**							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
30 min. average	✔							
1 h average	✔	✔	✔	✔	✔	✔	✔	✔
8 h average	✔				✔			
24 h average		✔		✔	✔	✔	✔	✔
Annual average	✔	✔	✔	✔	✔	✔	✔	✔
50 percentile								
90 percentile								
95 percentile								
98 percentile	✔	✔	✔	✔	✔		✔	✔
Exceedances of								
– national standard	✔	✔		✔	✔		✔	✔
– WHO Air Quality Guidelines	✔	✔		✔	✔		✔	✔

Table 18 - continued

UZB	Report of Data							
	CO	SO_2	NO	NO_2	O_3	BTX	TSP	PM_{10}
20 min. average [1]	✔	✔	✔	✔	✔		✔	
1 h average								
8 h average								
24 h average	✔	✔	✔	✔	✔		✔	
Annual average	✔	✔	✔	✔	✔		✔	
50 percentile								
90 percentile								
95 percentile								
98 percentile								
Exceedances of								
– national standard	✔	✔	✔	✔	✔		✔	
– WHO Air Quality Guidelines								

[1] only 3 data per day

From Table 17 can be seen that data are reported monthly, with the exception of EST 2 and H. Annual reports are issued by all networks except H. Often additional periods are used.

From Table 18 may be derived that the WHO Air Quality Guidelines have gained entry to the assessment of air quality in some of the surveyed countries. The networks BG (only for PM_{10}), CZ 1, HR, LV (only for SO_2), RUS and SLO evaluate the air quality in comparison to the WHO Air Quality Guidelines.

4 DISCUSSION

This chapter discusses some aspects of the air quality monitoring networks concerned and their QA/QC activities in the light of requirements for using air quality data for the health impact assessment (HIA) of air pollution with the software programme AirQ. Requirements for the design of the networks and a "good practice in air quality monitoring" for HIA are described in WHO (1999). Some results of the evaluation of the network status regarding requirements of WHO/ECEH for HIA are summarised in Table 19.

As stated in Chapter 1, the aim of the report is to support countries of the WHO European Region that are not EU Member States on their way towards a harmonisation process in air quality monitoring. International commitments concerning the improvement of air quality require the same quality of data for evaluation, i.e. comparability of data. This - vice versa - requires developed and well-harmonised QA/QC programmes, as different methods for data acquisition, data validation processes and data reporting have been established within the networks.

Networks, Sites and Methods

Although the selected networks are national ones (see Table 2), many of them are embedded in international programmes like EUROAIRNET, EMEP and GAW. This is another reason for comprehensive QA/QC programmes (EUROAIRNET 1999a, EUROAIRNET 1999b, EMEP 1995).

It is recommended to define the overall monitoring objectives of an air quality monitoring network thoroughly (WHO 1999). This step should be seen as the first step in the design of a network and has direct implications for the evaluation of a QA/QC programme.

Among other monitoring objectives, the objective "population exposure and health impact assessment" is of specific interest for WHO. In WHO (1999) is discussed that the use of monitored and reported air quality data for HIA is sometimes restricted, especially in cases where population exposure to air pollution is not explicitly addressed in the design of an air quality monitoring network.

From Table 4 is derived that about 75% of the networks include the objective "population exposure and HIA". In the first step these networks might be identified as a target group for the WHO European Programme on Health Impact Assessment of Air Pollution (Table 19).

Table 19: Evaluation of Network Status Regarding Requirements for HIA according to WHO/ECEH (WHO 1999)

Evaluation of Results					
Country	Objective HIA	Share of exposure relevant stations [1](%)	Sufficient data for HIA [2]	Status of QA/QC [6]	Status of data management [7]
AL	yes	100 (1/1)	no	-	-
BG	yes	3 (3/106)	no	+	-
CZ 1	yes	62 (87/140)	yes	+	+/-
CZ 2	yes	27 (45/168)	yes	+	+/-
EST 1	no	67 (2/3)	yes	+/-	-
EST 2	no	0 (0/3)	yes	+/-	+/-
H	yes	24 (5/21)	yes	+/-	+/-
HR	yes	16 (11/70)	yes [3]	+/-	+/-
LT	yes	23 (6/26)	yes [4]	-	-
LV	yes	64 (7/11)	yes [5]	-	+/-
RUS	yes	40 (250/627)	no	-	-
SLO	yes	8 (1/12)	yes	+	+
UZB	no	26 (19/72)	no	-	-

+ good with respect to recommendations of WHO (1997) and/or WHO (1999)
+/- partly good with respect to recommendations of WHO (1997) and/or WHO (1999)
- improvements necessary with respect to recommendations of WHO (1997) and/or WHO (1999)

[1] stations at urban background and suburban/residential locations (in brackets: number of stations at exposure-relevant sites / total number of stations)
[2] according WHO (1999), Annex 5, and requirements for the use of AirQ
[3] except manual methods for NO_2, O_3
[4] except manual methods for CO, SO_2, NO_2
[5] except manual methods for NO_2
[6] evaluation of Tables 8, 10, 12 (see text for criteria)
[7] evaluation of Tables 15, 16, 18 (see text for criteria)

For health impact assessment, relevant air monitoring stations have to be selected, i.e. stations representative for areas where most of the population is exposed. A high share of exposure-relevant stations, located in the urban background and in suburban/residential areas, indicates their relevance for HIA (WHO 1997). In many networks, a surprisingly low number of stations is situated at these locations (see Table 5) compared to the total number of stations of a network (Table 19).

A detailed description of criteria for the classification of sites can be found in EUROAIRNET (1999a). The criteria developed herein are harmonised with the criteria of WHO (1997). This concerns station type (traffic, industrial, background), type of zone (urban, suburban, rural) and characterisation of zone (residential, commercial, industrial, agricultural, natural and combinations of these characterisations). The criteria for stations measuring natural background (remote stations) and rural background (regional stations) were adopted in EUROAIRNET (1999a) from requirements of EMEP (1996).

One important requisite for the assessment of environmental health impacts of air pollutants is the knowledge of the actual prevailing concentration levels over time. The use of aggregated pollution indices is not recommended for HIA for reasons of divergent health effects of some pollutants combined (WHO 1997).

Table 20 analyses in a pollutant-specific way the percentage of monitoring stations (from Table 6) which are located at exposure-relevant sites.

Table 20: Pollutant-specific Evaluation of Monitoring Stations Regarding Requirements for HIA

Allocation of Monitoring Stations to Exposure-relevant Sites[1] (%)						
Country	**CO**	**SO_2**	**NO_2**	**O_3**	**TSP**	**PM_{10}**
AL	N.A. (-/-)	100 (1/1)	N.A. (-/-)	N.A. (-/-)	N.A. (-/-)	N.A. (-/-)
BG	0 (0/3)	3 (3/100)	3 (3/100)	0 (0/6)	0 (0/97)	0 (0/4)
CZ 1	36 (4/11)	60 (80/133)	60 (12/20)	64 (7/11)	61 (66/109)	63 (12/19)
CZ 2	17 (6/36)	26 (42/163)	26 (26/99)	20 (7/35)	22 (14/65)	25 (23/93)
EST 1	0 (0/1)	67 (2/3)	67 (2/3)	0 (0/1)	0 (0/1)	N.A. (-/-)
EST 2	N.A. (-/-)	0 (0/3)	0 (0/3)	0 (0/3)	N.A. (-/-)	N.A. (-/-)
H	16 (3/19)	24 (5/21)	24 (5/21)	28 (5/18)	N.A. (-/-)	13 (2/15)
HR	N.A. (-/-)	19 (11/58)	29 (10/35)	33 (1/3)	17 (1/6)	100 (1/1)
LT	33 (2/6)	23 (6/26)	23 (6/26)	0 (0/1)	26 (6/23)	0 (0/1)
LV	N.A. (-/-)	64 (7/11)	64 (7/11)	70 (7/10)	N.A. (-/-)	N.A. (-/-)
RUS	39 (221/562)	40 (250/627)	40 (250/627)	N.A. (-/-)	37 (217/588)	N.A. (-/-)
SLO	0 (0/3)	11 (1/9)	0 (0/5)	10 (1/10)	0 (0/1)	0 (0/4)
UZB	27 (15/55)	26 (19/72)	26 (19/72)	19 (3/16)	56 (19/34)	N.A. (-/-)

N.A. not applicable (pollutant not measured)
[1] stations at urban background and suburban/residential locations
(in brackets: number of stations at exposure-relevant sites / number of stations for a given pollutant)

In many networks, a high percentage of stations is not located at exposure-relevant sites. For instance with regard to NO_2: only three networks set up more than 50% of their stations on measurement sites that are suitable for exposure assessment of the broad population.

In an earlier investigation of WHO CC (Mücke and Turowski 1995), the networks of BG, CZ 1, CZ 2, H, HR and SLO had already been considered, among others. A comparison of the components measured of this report with those of the report of 1995 indicates certain trends in the measuring programmes of the networks in question. New components (O_3, BTX, PM_{10}) were introduced into the measuring programme of BG. In the network of CZ 1 the number of monitoring stations was reduced for NO_2 and increased for SO_2 and TSP. The network of CZ 2 increased the number of monitoring stations for CO, SO_2 and NO_2. Furthermore, the pollutants O_3 and PM_{10} were introduced for measurement. No big changes were made in the network of H. The network of SLO increased the number of stations for CO, NO_2 and O_3 and introduced the monitoring of PM_{10}.

The shift from monitoring TSP to monitoring PM_{10}, which can already be noticed in some networks, will certainly continue over the next years. This fact can be explained by the increasing knowledge about the more severe adverse health effects of the fine fraction of particulate matter (WHO 2000) and the coming into force of the Council Directive 1999/30/EC of the European Communities that also includes limit values for PM_{10} (EC 1999). Thus, an accelerated change from TSP measurement to PM_{10} measurement can be recommended in order to address this health-relevant component sufficiently. For the accession countries to the European Union, their compliance with the EU legislation will be required in the near future.

The variability of measurement methods, the minimum averaging time and the frequency of measurement, which can be found within various networks (Table 7), limit the direct use of AirQ for HIA in those networks, where no sufficient data are available (Table 19). A health-based assessment of CO and NO_2 needs one-hour averages. For the assessment of O_3, maximum one-hour and maximum eight-hour averages of a day are requested. Daily (24-hour) averages are needed for SO_2, TSP and PM_{10} (WHO 1999).

As a consequence, the sampling strategy of three to four samples per day, which can be found in many networks using manual methods for CO, SO_2, NO_2 and O_3, cannot fulfil the criteria above for HIA. Also, these measurements give no basis for the detection of exceedances of WHO guideline values for CO, NO_2 and O_3, which require a higher resolution in time of measurement.

In some cases, estimations and dispersion modelling may help to improve the information for HIA. Nevertheless, the introduction of automatic methods for CO, NO_2 and O_3 is essential for the validation and use of these models. Some data gaps for areas under surveillance could be filled even with manual methods if measurement campaigns were performed with the frequency of measurement necessary.

At EU level, standardised reference methods for sampling, calibration and analysis are required for each pollutant (EC 1999). This provision will gain importance for the accession countries as other methods are allowed only if comparable results to the reference method are achieved.

QA/QC Systems

The number of documented on-site visits required to achieve reliable results strongly depends on the monitoring devices used in the networks. Nevertheless, recommendations for the frequencies of certain on-site checks are given in WHO (1999). Automatic monitors should be calibrated (span gas, zero gas) every 24 hours. Active sampling systems (pumps) for subsequent manual analysis should be checked and calibrated at every site visit. For this and other site visit operations listed in Table 8 a weekly to monthly frequency is recommended, bearing in mind geographical constraints and the sufficient availability of qualified personnel. The review of Table 8 shows lacks concerning some of these QA/QC activities of the networks.

Audits and intercalibrations are essential in a QA/QC system, especially for large networks. A frequency of at least once a year is recommended for audits. Intercalibrations should be performed every 3 to 6 months, depending on the network type, to establish a direct measurement traceability chain to primary standards (WHO 1999).

The EU Framework Directive (EC 1996) requires regular participation in QA/QC programmes. Accession countries to EU are invited to intercomparisons with automatic analysers by the EU Joint Research Centre/European Reference Laboratory for Air Pollution (JRC/ERLAP) in Ispra/Italy, in October 2000.

Compared to the recommended frequencies of regular QA/QC operations, lacks in the QA/QC systems are apparent in most of the networks (Table 10). Problems in data comparability will arise in networks where no or little attention is paid to the conduction of intercomparisons. This is the case in about two thirds of all networks surveyed. At the minimum, the networks using manual methods should perform intercomparisons of the calibration standards used on a laboratory scale. Automatic networks should conduct intercomparisons with the complete measurement system at each site.

The involvement of subordinated branches and external organisations in on-site operations (Table 9) and in audits and intercalibrations (Table 11) shows clearly the need to include these institutions into a QA/QC programme, e.g. by means of a QA/QC handbook and training components (Table 12), under the responsibility of the central laboratory. The out-sourcing of audits provides the advantage of a control function. Nevertheless, external organisations are involved only to a small extent for this task (Table 11).

Table 19 makes an attempt to classify roughly the status of the QA/QC activities of the networks by evaluating the Tables 8, 10 and 12.

Indicators for the evaluation of the *site visit functions* (Table 8) are:

- For automatic methods: daily calibration of the monitors
- For manual methods: check of sampling systems and calibration of pumps with every site visit, i.e. at least once per month
- Other site visit functions: good performance, if all tasks are fulfilled in monthly or shorter intervals (not more than two criteria missed).

Indicators for the evaluation of *audits and intercalibrations* of the whole network (Table 10) are:

- Good performance, if intercalibrations are fulfilled at least twice a year
- For other tasks mentioned: good performance, if all tasks are fulfilled at least once a year.

An indicator for the evaluation of *training courses for subordinated branches* and laboratories (Table 12) is:

- Good performance, if training courses are regularly offered, i.e. at least once per year.

As mentioned before, our evaluation is based on the requirements and recommendations of WHO (WHO 1997 and WHO 1999). The indicator for our evaluation of *QA/QC measures* is set as follows:

> The status of the *QA/QC measures* of a network is in good compliance ("+") if not more than one of the criteria above is missed. "+/-" is given if not more than two of the criteria are missed, and "-" if more than two criteria are missed (Table 19).

From Table 13 can be concluded that the intercomparison workshops of WHO CC are of vital importance for the quantitative assessment of data for many networks. As the participants' countries are not part of the European Union, ERLAP has not been responsible for these countries. However, ERLAP has expanded its activities to EU accession countries, from the year 2000 onwards.

Workshops of WHO CC will still be required by the Member States of the WHO European Region.

Data Management

Good accuracy and precision of data is the key to reliable and comparable results. This survey indicates that high efforts should be undertaken to define accuracy and precision levels as a data quality objective if they are not introduced already. Even if the actual variations of the measured data are unknown and method-specific values are to be defined, the broad differences in the set values, ranging from 3 to 25 % for precision (Table 15), indicate a big variation in the comparability of the data among the air quality monitoring networks.

In EUROAIRNET, an accuracy and precision of ≤ 10 % and additionally a precision ≤ 2 ppb is required as an overall uncertainty (EUROAIRNET 1999a). These data quality objectives are stricter than the criteria of EMEP and the criteria of EC (1999). In EMEP (1996), an accuracy of ≤ 10 % for SO_2 and NO_2 is required, ≤ 15 % for other components, and an overall uncertainty combining sampling and chemical analysis of 15 to 25 %. These uncertainties are regarded to be sufficient in order to provide a valid basis for the control of dispersion models of air pollutants. To meet the data quality objective "detection of exceedances of limit values", the Council Directive (EC 1999) provides a combined accuracy and precision of 15 % for SO_2, NO_2, and 25 % for PM and lead.

From the standpoint of HIA and the experience from our WHO CC intercomparison workshops, the EC criteria may be proposed as being sufficient and reasonably achievable.

From Table 16 can be derived that the data quality objective "capture rate" is to be introduced into many networks, especially for those networks equipped with automatic methods. The minimum requirements should be the 50 % criterion for the 24-hour and annual averages and the 75 % criterion for the one-hour and eight-hour averages, which are presented in WHO (1999).

In comparison to EUROAIRNET, where an annual capture rate ≥ 90 % is proposed (EUROAIRNET 1999a), and in comparison to EC (1999) and EMEP (1996), which require ≥ 90 %, the WHO criteria are less strict.

The appropriate format of reported data is the last prerequisite for HIA, which is discussed in the context of this status report. A one-hour average is needed for CO, NO_2 and O_3, an 8-hour average for O_3, and 24-hour averages for SO_2, TSP and PM_{10}. For all components, annual arithmetic means and the 98^{th} percentile should be reported (WHO 1999). Inconsistent data formats, which are found in most networks surveyed (Table 18), hinder the usage of the AirQ calculation model proposed for HIA.

The last column of Table 19 shows a comparison of the networks with respect to the WHO requirements for data management (Tables 15, 16 and 18).

Indicators for the evaluation of the data quality objectives *accuracy and precision* (Table 15) are:

- Good performance, if accuracy and/or precision are achieved ≤ 10%
- Adequate performance, if accuracy and/or precision are achieved ≤ 25%
- Limited performance, if no criteria are set.

Indicators for the evaluation of the *capture rates* (Table 16) and *reported formats* (Table 18) are:

- Good performance, if not more than one of the following criteria is not met:

  ⇱ 75% of the one-hour averages for CO

  ⇱ 75% of the one-hour averages for NO_2

  ⇱ 75% of the one-hour averages for O_3

  ⇱ 75% of the eight-hour averages for O_3

  ⇱ 50% of the 24-hour averages for SO_2

  ⇱ 50% of the 24-hour averages for TSP

  ⇱ 50% of the 24-hour averages for PM_{10}.
- Adequate performance, if two of the criteria above are not met
- Limited performance, if more than two of the above criteria are missed, or
  if no criteria exist.

Important note: A component, which is not measured in the network, is not considered in the above performance rating.

The criteria for our evaluation of the *status of data management* are set as follows:

Good compliance ("+") if both, data quality objectives and capture rate/formats of data, are fulfilled with a good performance. "+/-" is given if one, and "-", if both of these criteria are not fulfilled with a good performance (Table 19).

5 CONCLUSION

The data quality objectives set by the network managers and the design of the network in a specific region or country determine how useful the generated data are for assessing population exposure to ambient air pollutants. This report aimed to describe the current status and major QA/QC activities of networks as obtained from a questionnaire in 1999. In a second step the compliance of the network design was evaluated with respect to criteria for health impact assessment set by WHO/ECEH.

This status report shows that QA/QC measures are recognised to be essential in almost all networks surveyed.

Attention should be paid to the definition and the location of stations relevant for exposure assessment of the majority of the population, i.e. urban background and suburban/residential areas (WHO 1999). Otherwise the monitored air quality data cannot be related directly to health data.

In most networks, incomplete temporal data coverage and low spatial coverage of the pollutants at exposure-relevant sites will probably limit a sound HIA. Additionally, most manual measurement methods lead to lack of data for HIA. But for financial constraints, many networks will not be able to switch completely to automatic monitors within the near future. These manual networks should implement additional means for air quality assessment (emission inventories, predictive models) besides air quality monitoring.

Harmonisation needs are identified for the QA/QC activities concerning site visit functions, audits and intercalibrations of the networks. The exchange of experience and information should be supported. As an outcome of this status report and from discussions with the participants, it is recommended to increase the financial expenditures for the improvement of the QA/QC programmes in many of the networks surveyed. It is also recommended to revise and update the design of air monitoring networks by increasing the number of stations at exposure-relevant sites.

The data quality objectives accuracy and precision, capture rates and formats for report of data should be harmonised to improve the reliability and comparability of data.

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Annex 1
WHO Quality Assurance and Control Questionnaire
1999

Annex 2
Air Quality Monitoring Networks
and
Contact Addresses

Acronym	Country	Name of Network	Network Operation and Management	Contact Address	Phone and Fax Numbers, E-mail
AL	Albania		Institute of Hydrometeorology Tirana Academy of Science Tirana Albania	Manjola Harja Academy of Science Institute of Hydrometeorology Durresit Str. 219 Tirana Albania	Phone: +355-42-235-18 or: +355-42-224-39 Fax: +355-42-235-18 E-mail: mitats@yahoo.com
BG	Bulgaria	National Air Monitoring Network	National Centre of Hygiene Medical Ecology & Nutrition Sofia Bulgaria	Dobrinka Lolova National Centre of Hygiene Medical Ecology & Nutrition Department of Air Hygiene Boul. Dimitar Nestorov 15 Sofia 1431 Bulgaria	Phone: +359-2-58-30-47 Fax: +359-2-973-35-46 E-mail: nikifor@mbox.cit.bg
CZ 1	Czech Republic	Hygienic Service	National Institute of Public Health Prague Czech Republic	Bohumil Kotlik National Institute of Public Health Dept. Air Hygiene Srobarova st 48 10042 Prague 10 Czech Republic	Phone: +420-2-67-08-23-75 Fax: +420-2-67-08-23-03 E-mail: hygiena.ovzdusi.szu@ telecom.cz
CZ 2	Czech Republik	National Air Monitoring Network	Czech Hydrometeorological Institute (CHMI), Prague Czech Republic	Jirí Novak Czech Hydrometeorological Institute (CHMI), Ambient Air Monitoring Branch and Laboratories Na Sabatce 17 14306 Prague 4 - Komorany Czech Republic	Phone: +420-2-472-79-35 Fax: +420-2-472-79-35 E-mail: novakj@chmi.cz

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LV	Latvia	Latvian Air Quality Monitoring Network: regional EMEP/GAW stations	Latvian Hydrometeorological Agency Riga Latvia	Irena Bistrova Latvian Hydrometeorological Agency Maskavas st 165 1019 Riga Latvia	Phone: +371-7113-275 Fax: +371-7145-154 E-mail: vktl@meteo.lv
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