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**REVISED GUIDELINES FOR STRENGTHENING ENVIRONMENTAL MONITORING
AND REPORTING BY ENTERPRISES¹**

SUMMARY

This document covers issues involved in establishing a system for environmental monitoring and reporting by enterprises including the legal basis, monitoring approaches and types, and cost issues; the composition of an enterprise monitoring programme; quality assurance and control; record keeping and reporting; data management by the public authorities; and measures to promote enterprise monitoring and reporting. The Working Group is expected to finalize these guidelines for transmission to the Committee on Environmental Policy for adoption.

¹ Prepared by the Workshop on Environmental Monitoring and Reporting by Enterprises held in Debe (Poland) on 4-6 September 2006. This document is being submitted on the above date because of processing delays.

INTRODUCTION

1. The preparation of pan-European environmental assessments, data collection for country environmental performance reviews and reporting under multilateral environmental agreements reconfirmed that substantial improvements in environmental monitoring and data collection are needed in Eastern Europe, Caucasus and Central Asia (EECCA) especially in such issues as air emissions, water discharges and waste management. Such improvements are difficult to achieve without the commitment and cooperation of enterprises. These include facilities and installations under public, private or mixed ownership that are obliged to collect data and report on their environmental impact and their compliance with environmental permits and standards (including limit values) to the public authorities.
2. Strengthening enterprise environmental monitoring and reporting contributes to several objectives of the EECCA Environmental Strategy adopted at the Kiev Ministerial Conference "Environment for Europe", most importantly as concerns pollution prevention and control, monitoring and public information. It will improve monitoring of enterprise compliance with environmental regulations. It also will help to improve data collection in order to produce national state-of-the-environment reports and other assessments for decision-making. Furthermore, it will facilitate environmental reporting to the international community. Last but not least, increasing the quantity of environmental information produced by enterprises, improving the quality of this information and enhancing access to it by the general public will help to exert significant pressure on polluters to reduce their adverse environmental impacts.
3. The main problems that should be addressed when reviewing and revising the existing enterprise environmental monitoring systems are the following:
 - (a) Shortcomings or contradictions in setting basic requirements for enterprise environmental monitoring in legislation;
 - (b) Lack of coordination and communication between various environmental, health and statistics authorities at different levels in handling environmental data that are collected and reported by enterprises;
 - (c) Lack of trust between public authorities and industry;
 - (d) Lack of a commitment by the general management of industries to environmental issues and a tendency to delegate these to an environmental department or an individual within the company; and
 - (e) Failure to set requirements for environmental data collection by enterprises and for management of the resulting databases by relevant public authorities in such a way as to support environmental decision-making, improve reporting to the international community and facilitate public access to information on enterprise environmental monitoring.

I. OBJECTIVES OF THE GUIDELINES

4. The present guidelines aim to promote better enterprise environmental monitoring in EECCA and other interested countries on the basis of good practices developed in various parts of the UNECE region and taking into account the requirements of relevant multilateral environmental agreements, such as the Protocol on Pollutant Release and Transfer Registers (PRTR) to the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters and supranational instruments such as EU Directive 96/61/EC on Integrated Pollution Prevention and Control (IPPC).

5. The public authorities can use the guidelines to introduce a framework for enterprise environmental monitoring requirements that would achieve a higher level of environmental protection. Industrial operators, meanwhile, will be able to develop and implement effective enterprise environmental monitoring programmes that have value added for them as well. Better enterprise environmental data collection will help the management to understand the effects of the company's environmental performance on profitability, market value, and investment decisions. The guidelines may also help to establish similar or compatible conditions for business and industry throughout the region in their environmental monitoring and reporting thus avoiding impediments to investments and trade.

6. The guidelines are also intended to promote understanding of public interests in implementing enterprise environmental monitoring and specific parameters that should be considered during the design of the monitoring programmes. They reflect the general need to make the environmental protection a shared responsibility of different stakeholders and the goal of authorities to establish strategic partnerships with stakeholders. Another factor is the increased need for socially responsible behaviour by industry especially in the environmental field.

II. GENERAL RULES FOR ENTERPRISE ENVIRONMENTAL MONITORING

A. Definition and purpose

7. Enterprise environmental monitoring is the system of measures implemented and paid for by operators to monitor their compliance with environmental legislation and their environmental performance. Such a system includes the recording of the results of the monitoring and the reporting of these results to the public authorities and the general public. The operator is the natural or legal person exercising actual power over the technical functioning of the facility.

8. The ultimate purpose of strengthened enterprise monitoring should be the evaluation of process conditions, process releases, environmental conditions and the effectiveness of environmental management. Consequently, the operators themselves are the primary users of enterprise environmental monitoring data. As a priority, mandatory enterprise monitoring systems should ensure, step-by-step, that the operators accurately report releases of pollutants exceeding relevant thresholds to air, water (to surface water, to sewers without a final waste-water treatment plant and to off-site waste-water treatment plants) and land (including by underground injection) as well as off-site transfers of waste or waste water fed into a (public) sewer system. Reporting of

waste avoidance or minimization, other nuisance and effectiveness of environmental protection measures may be a longer-term objective.

9. By requiring better enterprise environmental monitoring, public authorities should aim at obtaining benefits for the society as a whole (reaching an appropriate balance between environmental, economic and social objectives) through:

- (a) Improved control over impacts on the environment and an earlier proactive response to irregular situations, based on the operator's knowledge of and experience about the process;
- (b) Higher management environmental awareness and responsibility for regulatory compliance and the prevention and reduction of adverse impacts of process releases on the environment;
- (c) Increased efficiency in energy and resource use and overall cost-effectiveness of the process, since good enterprise environmental monitoring provides useful information relating to energy use and materials flow;
- (d) Increased public access to information and public assessment of enterprise environmental performance, which may lead stakeholders to influence the operator to improve performance (e.g. through industry rating systems);
- (e) The use of enterprise environmental monitoring data by the public authorities as an addition to State monitoring programmes for environmental policy purposes.

B. Legal basis

10. National legislation should set at least basic requirements for mandatory enterprise environmental monitoring (e.g. terminology, basic principles, scope and methods of monitoring, and responsibilities of parties). This may relate to enterprises of a certain threshold capacity in the main polluting sectors of economic activity in the country. Legal requirements should be supplemented by regulations, for instance, guidelines for individual environmental media (e.g. air-quality requirements for enterprise zones) and individual industrial branches. The Protocol on PRTR and the guidelines for its implementation (www.unece.org/env/pp/prtr.docs.htm) provide guidance regarding the range of industries that should be subject to mandatory environmental monitoring and regarding the parameters to be monitored. The reference documents of the European IPPC Bureau (eippcb.jrc.es) and the upcoming Guidance Document for the Implementation of the European PRTR (www.eper.cec.eu.int/) can also be helpful in determining the list of components to be monitored in different sectors.

11. The legislation should also ensure that the public authorities have such (well-delineated and not mutually-conflicting) powers as:

- (a) Requiring operators to perform monitoring according to an endorsed programme;
- (b) Gathering additional information, sampling and analysing samples;
- (c) Having access to data (including viewing/copying entries into registries of primary monitoring data; ordering the operator to copy documentation and send it to the public authority);
- (d) Having access to the site for verification.

12. The legislation should also include detailed monitoring requirements regarding measurement programmes and frequency, sets of basic measurement parameters, reference standards and validation of results. This may help prevent disputes between the public authorities and individual operators and to avoid corruption as the costs of implementing monitoring programme may vary widely. The operator should generally be required to develop a draft enterprise environmental monitoring programme and to include a proposal for such a programme in the permit application. Depending on the quality of the programme the public authorities may either accept it or reject it and demand modifications. Once approved, the mandatory environmental monitoring programme should become part of the permit conditions and be legally binding. A clear link should be established between parameters regulated by permits and mandatory measurement parameters.

13. The obligation to conduct enterprise environmental monitoring should apply regardless of ownership. The same enterprise environmental monitoring requirements should be established for state-owned and private companies. A minimal and distinct set of reporting obligations may be set for small and medium-sized enterprises (SMEs). This may be better done within the permitting process. SMEs that are under reporting thresholds may be obliged to report information on their emissions and discharges (although not necessarily on a facility-specific basis), if these are significant at the local level. For other SMEs monitoring requirements could be set on a voluntary or pilot basis.

14. Operators should be allowed to perform the measurements themselves or engage an external organization to do it. The same requirements for quality assurance should be applied in both cases. These include standardized methods of measurement, certified instruments and personnel, and accreditation or verification of laboratories.

15. The operator should be obliged to submit enterprise environmental monitoring data to the public authority:

- (a) Periodically, according to a predefined schedule;
- (b) Immediately, when violations are discovered, or in the case of any incident or accident that is causing or may cause significant pollution; and/or
- (c) Upon the request of the public authority.

16. Besides analysis and reporting, the operator should be obliged to take actions for improvement when enterprise environmental monitoring data show non-compliance with regulatory requirements. The legislation should foresee penalties, including criminal sanctions in case of infringement of the enterprise environmental monitoring programmes and for false reporting, inexcusable failure to report, distortion of a monitoring device or falsifying or failing to keep records.

17. The national legal framework should define the obligations of public authorities which should collect, validate and manage environmental monitoring data from enterprises, as well as deal with accessibility to the data and confidentiality issues. A “single-window” approach should be introduced, step by step, to facilitate enterprise environmental reporting to the public authorities. If necessary, a new legal instrument should be developed to ensure a comprehensive and workable system leading to the establishment of a national PRTR.

C. Monitoring approaches

18. Enterprises should use (a) direct monitoring based on measurements; (b) indirect monitoring based on estimates (obtained through, e.g., use of surrogate parameters, mass balance calculations or emission factors); or (c) a combination of these two approaches. The choice of monitoring approach will be based on the following criteria:

- (a) Fitness for purpose (i.e. is the method suited to the original reason for monitoring?)
- (b) Compliance with legal requirements (i.e. is the method in line with international and national legislation?);
- (c) Adequacy of facilities and expertise (i.e. are the available technical equipment and the professional expertise of the staff adequate for the proposed method?).

19. **Surrogate parameters** are measurable indices which can be directly or indirectly related to standard direct measurements of pollutants and which may be monitored and used instead of direct release indices. They can give early warning of possible increases in emissions and can sometimes be even more accurate than direct measurement results. The use of surrogates may not always be possible, however, and it may be valid only for a certain range of process conditions. Other disadvantages of surrogates include the lack of public confidence in them compared to direct measurements and their unsuitability for legal procedures.

20. **Mass balance** monitoring is a method that accounts for inputs, accumulations, outputs and the generation or destruction of the substances in question. The releases to the environment are then calculated based on the difference in balance. Mass balances can be used to estimate the emissions from a facility, process or technological unit. Mass balances can be used only when the exact input, output and quantities can be determined. Discrepancies connected with the tracking of individual materials or with other activities at each stage of material handling can result in large deviations for total facility releases, however. A slight error at any one step of the operation can significantly affect release estimates.

21. **Emission factors** are values that can be used to estimate releases by multiplying these factors by the capacity of the installation or by its throughput data (e.g. production output or water consumption). Emission factors are in general expressed as the amount of a pollutant released divided by the unit of throughput (weight, volume etc.) of the facility emitting the substance - for instance, kilograms of pollutant emitted per cubic metre of combustion gas. Where the emission factor is known for the process without abatement equipment, an additional factor describing the removal efficiency of the abatement technique needs to be known. Empirical relationships or emission factors do not always exist for all sources. In these cases direct measurement of releases is the only way to obtain an estimate of the amounts of pollutants.

22. The approach to be adopted in a monitoring programme may be chosen, proposed or specified for use by the public authority or the operator. (In the latter case, approval from the authority is needed.) In each situation, the public authorities should weigh the need for, and the added value of, direct measurements against the possibility of simpler verification using indirect methods. Whenever direct measurements are not used, the relationship between the method used and the parameter of interest should be demonstrated and well documented.

D. Types of monitoring

23. Enterprise environmental monitoring generally includes: operation monitoring, emission monitoring and monitoring of environmental quality.

24. **Operation monitoring** is the measurement of the physical and chemical parameters of the technological process in order to confirm that the plant is functioning within the required limits. Examples of the parameters to be measured are the pressure or temperature in the reactor and the flow rate of raw materials. Operation monitoring also includes supervision of the operation of pollution control devices to make sure that they are functioning properly. It should guarantee the prevention of process malfunctions and the minimization of environmental impacts.

25. **Emissions monitoring** is the supervision and measurement of emissions and releases from the plant at source. It includes the continuous measurement of production losses, air emissions, wastewater discharges, amounts of hazardous and non-hazardous wastes and nuisances (noise etc.).

26. **Monitoring of environmental quality** is the monitoring of pollution levels within the environment surrounding the facilities and the effects of operation on human health and ecosystems. The purpose of environmental-quality monitoring is to make sure that environment quality and human health objectives are realized. This monitoring includes measurement of the effects of wastewater on water quality and biota. It also includes monitoring of the impacts of emissions on air quality. In some cases it is necessary to monitor soil and ground water quality in the neighbourhood of facilities and dumping sites and to assess the effects of air pollution on flora and fauna. Even if operators do not perform environmental-quality monitoring themselves, they should cover its costs. Environmental-quality monitoring may be contracted out to specialized organizations which have the required competence. The environmental-quality monitoring programme should be agreed with the public authorities and discussed with other stakeholders, such as representatives of the general public.

27. The public authorities should decide on the specific parameters of emissions and environmental-quality monitoring. The operation parameters to be monitored will be defined by the operator on the basis of regulatory and technical documentation. Exceptions may apply for the monitoring of parameters that are crucial for calculating emissions indirectly or describing the conditions that are relevant for emissions and environmental-quality monitoring. The public authorities may also impose special terms for operation monitoring of purification or abatement equipment.

E. Timing considerations

28. Various timing considerations should be taken into account when setting monitoring requirements for enterprises. It is important to establish the exact time when samples or measurements should be taken. Other relevant factors are the averaging time of the measurement result and the frequency of sampling.

29. The basis for the monitoring timing requirements is the description of the emission limit value (ELV) in the permit. ELV requirements and corresponding compliance monitoring should

be clearly defined and indicated in the permit so as to avoid misunderstandings. ELVs can be set with various averaging times (hour, day, month, year, etc.) or maximum peak values can be established, and the monitoring programme should make it possible to check compliance with ELVs based on different averaging times. In establishing timing requirements, the type and size of the facility should also be taken into account and these conditions should preferably be regulated directly by legal act.

30. The total duration of an enterprise environmental monitoring programme is linked to the operating life of a process. In case of environmental-quality monitoring, the public authorities should require, where necessary, an assessment before a process has begun operating in order to establish the baseline ambient status. The pre-operation monitoring programme depends on the risk of the facility and the specificity of the area surrounding the site. Enterprise environmental monitoring will sometimes be required to continue under the responsibility of the operator after a process has ceased to operate if its harmful effects are more durable. For example, groundwater can be monitored after the closure of fuel depots or landfill sites. The post-operation enterprise environmental monitoring should be determined for individual facilities based on the likelihood of remote effects of their processes.

F. Costs of enterprise environmental monitoring

31. The “polluter pays” principle is the basis for enterprise environmental monitoring and therefore the polluter should cover the costs of monitoring. Assessment of the costs of enterprise environmental monitoring should be undertaken to reach an optimal balance between the scope and accuracy of enterprise environmental monitoring and the associated costs. A general rule in designing enterprise environmental monitoring programmes is that a streamlined monitoring system that works well will always be better than a more complicated system that does not work properly. Optimization of costs should be performed when possible but always without losing sight of the overall objectives of enterprise environmental monitoring.

G. Access to information

32. Members of the public should be given access to review draft monitoring programmes within the permitting process. Information obtained through mandatory self-reporting should be made available to the general public through databases kept by the public authorities and through annual corporate reports and corporate databases open to the general public. Information should be made available in the form requested unless it is reasonable to make it available in another form or the information is already publicly available in another form. It should be made available free of charge or at such a minimum charge as to cover the cost of reproducing the information. Information should be specified geographically (i.e. identifiable by the geographical location of the facility where monitoring is conducted).

33. Members of the public should be granted access to the enterprise environmental monitoring information without having to state the reason for their interest. This can be done by ensuring, for instance, direct electronic access via the Internet. Under normal operating conditions, this should allow the information to be continuously and immediately available and its design should take into account the possibility of its future expansion and should include all data reported for previous reporting years.

III. ELEMENTS OF AN ENTERPRISE ENVIRONMENTAL MONITORING PROGRAMME

34. The parameters to be monitored, the frequency of monitoring, and the types, methods and organizational forms of monitoring may vary according to the risk that different categories of facilities pose for the environment and human health, individually or due to the high cumulative effect of multiple sources. The upcoming *Guide on Environmental Self-Monitoring by Industrial Operators in Kazakhstan* to be published by the Task Force for the Environmental Action Programme for Central and Eastern Europe will provide detailed recommendations in this regard.

A. Parameters measured

35. Enterprise environmental monitoring programmes should generally focus on main groups of parameters, as follows:

- (a) Use of raw materials and energy;
- (b) Raw material inputs and operating conditions (process temperature, pressure and flow rate etc.);
- (c) Channelled emissions of waste gases and particulate matter to ambient air through stacks or through any kind of pipe, regardless the shape of its cross-section;
- (d) Controlled discharges of wastewater via sewers to and from wastewater treatment plants, directly to receiving waters such as the sea, lakes, rivers and streams, and to land via septic tanks and soak ways;
- (e) Controlled disposals of solid waste to landfill sites; as well as controlled disposals of solid and liquid wastes to incinerators;
- (f) Diffuse (fugitive) releases to air, water and land. Diffuse releases result from the gradual loss of tightness of a piece of equipment designed to contain gases or liquids, which is generally caused by pressure or temperature differences and fluctuations. Examples of diffuse releases include leakages from a flange or pump and losses from storage facilities for gaseous or liquid products;
- (g) Releases that are accidental (including spilling, emitting, discharging, injecting, disposing or dumping) or through sewer systems without final waste-water treatment;
- (h) Levels of noise, vibration, odour and nuisances;
- (i) Technological conditions of the plant that should influence measurement timing considerations and may affect releases (used capacity in comparison with designed capacity);
- (j) Operational and maintenance parameters of monitoring and other relevant equipment; and
- (k) Impact on ambient air, water bodies, soil surface, groundwater and biota.

B. Main steps and elements

36. The following steps are involved in developing a monitoring programme for implementation by the operator:

- (a) **Specify programme goals.** The goals should be documented at the start and kept under systematic review. In addition to the understanding of data uses, the actual and potential

users of the monitoring data should be identified. The objectives of the monitoring need to be made clear to and discussed with the data's users and any third parties involved. The monitoring data should be regularly compared with the programme goals to ensure that these are being met.

- (b) **Establish responsibilities.** The mandatory environmental monitoring responsibilities of the operator should be clearly stated. The permit should include the statement that the principal responsibility for the monitoring and its quality remains with the operator even if the operator has used external contractors to undertake the actual monitoring work.
- (c) **Identify the programme's scope.** The programme should specify clearly and unambiguously the pollutants or parameters being monitored. As enterprise environmental monitoring should provide authorities with adequate information on emissions and their variations in time, in certain cases the number of parameters to be monitored may exceed the number of parameters for which ELVs are established. In that case the monitoring of additional parameters will have mostly an information function. The public authorities should avoid unjustified additional load to the operators.
- (d) **Decide on the approach and monitoring methods.** The enterprise environmental monitoring programme should first identify and describe whether direct or indirect monitoring is required. After that the technical details of particular methods are given. Different approaches can be chosen to monitor a parameter, including direct measurements, surrogate parameters, mass balances, emission factors and other calculations. When choosing one of these approaches for monitoring there should be a balance between the availability of the method, its reliability, level of confidence, costs and the environmental benefits.
- (e) **Specify the technical details of a particular standard or other measurement method and the units of measurement.** The operator should use only validated measuring methods, whose performance criteria are known and formally documented. Usage of standard methods required by the International Organization for Standardization (ISO) or other international standards, such as those of the European Committee for Standardization (CEN) or the American National Standards Institute (ANSI) is recommended. When necessary, internationally approved calculation methods such as the *Guidelines for National Greenhouse Gas Inventories* of the Intergovernmental Panel for Climate Change (www.ipcc-nggip.iges.or.jp/public/gl/invs4.htm) and the *EMEP/CORINAIR Atmospheric Emission Inventory Guidebook* (www.unece.org/env/lrtap/welcome.html) should be used. If these are not available or not applicable, national standards or alternative methods may also be used with the prior approval of the public authority. The permit should specify performance criteria for the method including uncertainty, limit of detection and specificity.
- (f) **Specify the timing requirements of sampling and measurements.** Several timing considerations are relevant for setting monitoring requirements in permits. The most important of them are time when samples or measurements are taken, averaging time and frequency. The frequency with which the parameter is monitored may vary depending on the needs, the risk to the environment and the monitoring approach taken.

- (g) **Specify unambiguously the location where sampling and measurements should be performed.** The sampling or measurement points should match the positions where the emission limit values are applied and should be based on requirements of sampling and measurement standards. The operator should provide for sampling or measurement sites according to enterprise reference documentation. Relevant requirements for technical facilities like measurement platforms and sampling ports should also be established.
- (h) **Define the operational conditions, including production loads,** under which the monitoring is to be performed. If average or nominal production or capacity at the facility is required this should be numerically set.
- (i) **Establish appropriate quality assurance and control requirements** so that the measurements or estimates are reliable, comparable, consistent and auditable. This includes calibration and maintenance of the monitoring system when necessary, the use of recognized quality management systems, periodic checks by an external accredited laboratory and certification of instruments and personnel under recognized certification schemes.
- (j) **Define the recording and reporting requirements,** specifying what results and other information are to be kept and reported, and when and how this should be done.
- (k) **Make arrangements for the assessment and reporting of exceptional and accidental releases.** Foreseeable exceptional releases occur during start-ups and shut-downs of the process and maintenance of the equipment.
- (l) **Establish an internal framework to ensure compliance,** including allocation of environmental responsibilities to the facility's personnel at all levels, a system of internal audits, corrective actions and staff training. Company management will need to carefully consider and use incentives for inducing environmentally responsible behaviour among staff, regardless of their position in the hierarchy.
- (m) **Provide a clear statement of the compliance control procedures and the response in case of non-compliance.** The uncertainty of the monitoring result should be taken into account in evaluating compliance with the relevant requirements.

37. The public authorities, in co-operation with accreditation organizations, should be responsible for assessing, endorsing and checking the correct implementation of the mandatory monitoring programme. Enterprise environmental monitoring does not change the duty of the public authorities to assess compliance through inspections and by using monitoring data from accredited laboratories that are not linked with the enterprise being checked.

IV. QUALITY ASSURANCE AND QUALITY CONTROL

A. Quality assurance and control

38. The public authorities should require operators to conduct data quality assurance activities in order to ensure the reliability of enterprise environmental monitoring data. Several types of such activities exist and the public authorities should determine which ones guarantee the obtaining of data of the highest quality. The main activity types are:

- (a) Sampling and analysis according to the required techniques and laboratory practices;
- (b) Performing analysis at certified or accredited laboratories;
- (c) Calibration of equipment according to designated techniques;
- (d) Self-certification of monitoring data; and
- (e) Participation in laboratory inter-calibrations and other evaluations.

39. Quality control activities should be used to ensure that measurement uncertainty is maintained within acceptance criteria for the attainment of the data quality objectives of the enterprise environmental monitoring programme. Quality control includes preparing protocols for site operation, equipment maintenance and record keeping. It is also necessary to prepare protocols for equipment calibration and site visit schedules, as well as for data inspection, review, validation and use.

B. Quality management systems

40. Environmental monitoring activities should be included into an overall quality management system for an installation. Quality management systems (e.g. BS EN ISO 9000) are useful for ensuring that the equipment and methods used in the measurements as well as the various monitoring tasks are carried out according to the requirements. Quality assurance includes maintenance and calibration procedures. Environmental management systems assist in the systematic management of monitoring data, for instance in relevant documentation and in the practical organization of the tasks.

41. Standards should be adopted setting competence requirements for the personnel carrying out the monitoring tasks and the laboratories participating in the work. The IPCC *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (www.ipcc-nggip.iges.or.jp/public/gp/english/gpgaum_en.htm) may be used for this purpose. Good practices for accessibility and quality in release data reporting are described in the *Reference Document on General Principles of Monitoring* published by the EU IPPC Bureau (<http://eippcb.jrc.es/>). The OECD's Resource Centre for PRTR Release Estimation Techniques (<http://206.191.48.253/>) provides access to guidance manuals on issues like emission factors, mass balance methods, engineering calculations and monitoring information.

C. Certification, accreditation and calibration

42. Certification is used to judge whether the monitoring facilities and activities at an installation conform to a specific standard. It should be done by an organization which is formally accredited as competent to do it and which is independent of the operator and authority. Certification involves systematically comparing different aspects of monitoring, such as equipment, quality management systems and personnel with documented criteria and procedures. Self-certification may also be desirable for all reports submitted by the operator and is used in some countries. The report must be signed by an authorized person or that person's authorized designee and must include a certification stating that the information submitted is true, accurate, and complete. The law should foresee sanctions in cases of falsification of reported data.

43. The use of accredited organizations and methods should be required for monitoring work. Accreditation is used formally to show that an organization is competent to do a specific task, or that a method is fit for a particular purpose. An analytical laboratory is accredited to do one or more specific analyses.

44. Calibration is used to test the performance of monitoring equipment against standard samples like gas cylinders and permeation tube systems. Calibration is done under controlled conditions and its aim is to check that the equipment is giving results, which are precise within the required limits. Calibrations should be repeated at regular intervals to ensure that the required performance is maintained. They may be done at an installation or in an off-site laboratory.

V. RECORD KEEPING AND REPORTING

A. Record keeping

45. The operator should record all sampling, analyses, measurements, examinations, calibrations and maintenance carried out in accordance with its environmental monitoring programme. Records should be kept a sufficient amount of time. In establishing the retention period it is necessary to follow the requirements of international agreements and national legislation. The retention period for records will depend upon the type of enterprise environmental monitoring, the parameter monitored, the category of facility and the demands for further analysis and verification of data. For instance, data on persistent pollutants should be kept for a period equal to the time required for their biodegradation in the environment. Data on toxic substances, especially carcinogens, should be kept for a period equivalent to the duration required for the manifestation of intoxication symptoms under chronic exposure, whether directly or through biomagnification.

46. The operators should ensure efficient data management, including the creation of automatic systems for information collection, recording, search and processing. Environmental data management systems should be entirely associated with systems of technological and financial management at the facility. The structure of databases and software supply of information systems should enable their future development.

B. Mandatory reporting

47. The operator should be required to present the results of mandatory environmental monitoring in summarized form to the public authorities. Besides helping to assess regulatory compliance and determine regulatory charges and environmental taxes, enterprise environmental monitoring provides data for emission inventories. These and other uses, should determine the character of reporting requirements.

48. From the large amount of data generated when a parameter is monitored, a summary of the results over a certain period of time should be presented to relevant stakeholders. Standardization of reporting formats facilitates the electronic transfer and subsequent use of data and reports. Depending on the medium and the monitoring method, the report may include averages (e.g. hourly, calendar day, monthly or annual averages) and/or peaks or values at a specific time or at times when the ELVs are exceeded. In addition to emission data and uncertainty assessment, adequate documentation of the data production chain and reference measurements should be presented.

49. Enterprise environmental monitoring data should be reported in line with agreed schedules and criteria, or in response to requests. The enterprise environmental monitoring programme should contain specific reporting conditions and schedules which will state how, when, by whom and to whom the data are to be reported, and what types of data are acceptable (e.g. calculated, measured, estimated). The schedules should specify the type of reporting, the frequency of recurring reporting and report submission dates. The schedule might cover the time-scales and locations of interest and the format of the data. It might also give details of relevant limits, the units to be used and any normalization required (e.g. to standard temperature and pressure conditions).

50. A data transfer system should allow a smooth and possibly automated data flow from individual operators to the public authorities and to a publicly accessible web site. The operators should use standardized reporting formats developed at the national level. The public authorities should make electronic reporting forms available on their web sites. Each operator should be assigned a user name, and a password so as to be able to download and submit these forms.

VI. DATA MANAGEMENT BY THE PUBLIC AUTHORITIES

51. Validation of data may be more easily achievable if responsibility is delegated to competent local or regional (subnational) authorities or to competent regional (subnational) or local offices of national authorities, since they will be closer to the operators and are more likely to have an overview of the latter's activities. It may be particularly useful to link the validation of the data to other controls of facilities – for example, via regular or extraordinary environmental inspections.

52. Once the authorities receive monitoring reports from enterprises, the responsible person should check these without delay and take necessary actions (e.g. request additional information, require that some data be verified, or conduct an inspection to validate data. After the responsible

person validates enterprise environmental monitoring data, these should be uploaded to the relevant database.

53. The legal and institutional structures for the collection of data may vary, according to the environmental medium. Although legal competence may be divided between various public authorities, one institution at the national level should be responsible for compiling the complete data set for the whole country. The same data should be used for all reporting purposes to afford conformity between the different databases. For instance, consistency of reported emission data should be ensured, as these data are used in preparing national emission inventories and in reporting to the governing bodies of multilateral environmental agreements.

VII. PROMOTION OF ENTERPRISE ENVIRONMENTAL MONITORING AND REPORTING

A. Establishing dialogue and optimizing costs and benefits

54. There is a need to establish constructive dialogue between the public authorities, members of the public and the operators in order to strengthen the motivation of industry to perform enterprise environmental monitoring and reporting adequately. There is a need to regulate the principles for the involvement of members of the public in defining the open parameters of enterprise environmental monitoring.

55. The public authorities should consider the costs of monitoring, data production, analysis and reporting when imposing monitoring requirements. Adequate scope and frequency of enterprise environmental monitoring should be established on the basis of dynamic, simple and transparent prioritisation rules. The public authorities should encourage operators and staff implementing enterprise environmental monitoring programmes to take account of opportunities to improve the cost-effectiveness of monitoring technologies.

B. Developing guidance and training personnel

56. The public authorities should develop or revise appropriate reporting forms and improve existing reporting methods (e.g. by establishing online reporting) and should develop guidance documents related to pollution measurement, calculation and estimation (or translate available international guidelines and disseminate them to operators). They should also aim at integrating open media-specific reports and reducing the frequency of mandatory environmental reporting. Introducing annual reporting could be a tool to meet the latter objectives. This should be decided in cooperation with the statistics departments. The public authorities should provide methodological support to enterprise analytical laboratories through the creation of national reference laboratories, involvement of enterprise laboratories in the international inter-calibration and training of personnel. Operators should involve organizations specialized in environmental reporting and reporting in the field of sustainable development in training their personnel.

C. Promoting environmental management systems

57. The public authorities should encourage operators to establish and enhance enterprise environmental monitoring programmes that go beyond regulatory requirements. Specific legal approaches, policy considerations and inducements should be considered to promote voluntary auditing and environmental management systems (EMS) that frequently include additional (voluntary) enterprise environmental monitoring. The results of such enterprise environmental monitoring cannot be used to penalize operators since they aim to reduce the risks to the environment. On the contrary, they are likely to reduce the chance of penalties being imposed for violations of legal requirements set by permit conditions or directly by legislation. Operators can use the results of monitoring to demonstrate their company's positive performance to customers and other stakeholders.

58. EMS focuses on the actual and potential environmental impacts of a company's production activities and services including the wider impacts on society and the municipality in which the company operates. The company should first develop an overall corporate environmental and sustainable development strategy. Specific targets, goals and objectives should be integrated into a strategy based on the concept of continual improvement in environmental performance. To measure improvement in a company's environmental performance, accurate and reliable statistical data are collected, along with other specific information about environmental impacts.

59. The public authorities should encourage operators to establish EMS based on ISO 14001 or the EU Eco-Management and Audit Scheme (EMAS) and publication of open environmental and sustainability reports by which stakeholders, clients and members of the public get information about the operator's environmental performance.

60. The public authorities should launch information campaigns and training programmes to demonstrate to operators that better environmental data collection and reporting using EMS can help them to, *inter alia*:

- (a) Establish environmental priorities and improve environmental performance;
- (b) Identify areas of wasteful and inefficient use of natural resources, materials and energy to improve processes and reduce costs;
- (c) Improve regulatory compliance with the possibility of less frequent inspections; and
- (d) Establish better relations and improved communication with the public authorities, employees, shareholders and the general public.

D. Corporate reporting and socio-environmental performance rating

61. Mandatory, regulatory environmental reporting and voluntary environmental and sustainability reporting do not contradict each other and are mutually complementary, providing complete information for public needs and most important exposure data for communities and other stakeholders.

62. In order to simplify complicated systems and to transmit meaningful information about the performance of an operator, company or geographic region, or to compare the performance of

different industries environmental indicators are used. These indicators may be used to report on environmental performance to the public including the investment, insurance and banking communities, and to set the framework for a methodical assessment of progress. The public authorities should encourage operators to use relevant indicators developed in accordance with international standards when reporting on their environmental performance.

63. The public authorities should encourage operators to disclose information through corporate reporting and to use relevant guidance developed in accordance with international standards to prepare corporate environmental and sustainable development reports. They should also consider harmonizing, as much as possible, regulatory reporting with international standards and benchmarks for corporate reporting. Operators may consider applying international principles and guidelines such as: universal social and environmental principles of responsible business approved by the UN Global Compact (<http://www.un.org/Depts/ptd/global.htm>), the guidelines for reporting sustainability promulgated by the Global Reporting Initiative (www.globalreporting.org), *Measuring Eco-Efficiency – A Guide to Reporting Company Performance* by the World Business Council for Sustainable Development (www.wbcsd.org) and the recommendations of the organization CSR-Europe (www.csreurope.org).

64. The public authorities should promote the creation of independent socio-environmental performance industry rating schemes based on enterprise environmental monitoring data and support the use of such ratings by industry associations, insurers, banks and the like for business self-regulation and to help to simplify enterprise information so as to make it more acceptable and meaningful for the general public.