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**ELEMENTS FOR GUIDELINES ON STRENGTHENING ENVIRONMENTAL  
MONITORING AND REPORTING BY ENTERPRISES<sup>1</sup>**

**SUMMARY**

This document covers issues involved in establishing a system for environmental monitoring and reporting by enterprises including overall principles, 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 public authorities; and measures to promote enterprise monitoring. The Working Group is invited to exchange preliminary views on the scope and content of guidelines intended for an in-depth discussion at a workshop in September 2006.

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<sup>1</sup> Prepared by the secretariat with the assistance of Mr. A. Sirendi, its consultant, and in cooperation with the Task Force for the Environmental Action Programme (EAP) for Central and Eastern Europe, Caucasus and Central Asia.

## 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. 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 facility 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.

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. As a priority, mandatory enterprise monitoring systems should ensure, step-by-step, that facility 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 at large 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 environmental awareness due to the creation of a mechanism for educating the operator about the need to comply with relevant laws, regulations and permits;
- (c) Augmented management responsibility for regulatory compliance and the prevention and reduction of adverse impacts of process releases on the environment;
- (d) Increased 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;
- (e) Increased public access to information and public assessment of enterprise environmental performance, which may lead to informal pressure on a facility to improve performance (e.g. through industry rating systems).

## **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 the main polluting sectors of economic activity in the country. The Protocol on PRTR and the guidelines for its implementation ([www.unece.org/env/pp/prtr.docs.htm](http://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](http://eippcb.jrc.es)) and the upcoming Guidance Document for the Implementation of the European PRTR ([www.eper.cec.eu.int/](http://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 governmental authorities have such 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 any documentation; ordering the operator to copy documentation and send it to the competent authority);
- (d) Having access to the site for verification.

12. Including detailed monitoring requirements (e.g. regarding measurement programmes and frequency, reference standards and validation of results) in the legislation should be considered,

when necessary. 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.

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 (although not necessarily on a facility-specific basis), if these emissions 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. 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. The use of surrogates may have many advantages in addition to cost-effectiveness. It 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 competent authority or the operator. (In the latter case, approval from the authority is needed.) In each situation, the competent 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 takes one of three forms: operation monitoring, emission monitoring and impact monitoring.

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. **Impact monitoring** is the monitoring of pollution levels within the environment surrounding the facilities and the effects of operation on ecosystems. The purpose of impact monitoring is to make sure that environment quality and human health objectives are realized. Impact 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 the impact monitoring themselves, they should cover its costs. The monitoring may be contracted out to specialized organizations which have the required competence. The impact-monitoring programme should be agreed with public authorities and other stakeholders, such as representatives of the general public.

27. The competent authorities should decide on the specific parameters of emissions and impact monitoring. The operation parameters to be monitored will be defined by the operator. 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 impact monitoring. The competent 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.

30. The total duration of an enterprise environmental monitoring programme is linked to the operating life of a process. Where necessary, the public authorities require 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 facility 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. As these costs can sometimes be very high they should be consistent with the benefits 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 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 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 self-monitoring may vary according to the risk that different categories of industrial 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, at least for key industries, should 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) Operation and maintenance of monitoring and other relevant equipment; and
- k) Impact on ambient air, water bodies, soil surface, groundwater and ecosystems.

**B. Main steps and elements**

36. The following steps are involved in developing a monitoring programme:

- 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;
- 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](http://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](http://www.unece.org/env/lrtap/welcome.html)) should be used. If these are not available, national standards or alternative methods can 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. The operator should provide for suitable sampling or measurement sites. 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 when evaluating compliance with the relevant requirements.

37. The competent public authorities 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 its own monitoring data.

#### IV. QUALITY ASSURANCE AND QUALITY CONTROL

##### A. Quality assurance and control

38. Public authorities should require operators to conduct data quality assurance activities in order to ensure the accuracy 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](http://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 a facility 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, under penalty of law, that the information submitted is true, accurate, and complete.

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. The retention period for records will depend upon the type of enterprise environmental monitoring (operational, emissions or impact), the parameter monitored and the category of facility. Data on persistent pollutants should be kept for a period equal to the time required for disintegration in the environment. Data on toxic substances, especially carcinogenic ones, should be kept for a period equivalent to the duration required for the manifestation of intoxication symptoms under chronic exposure, whether direct or through biomagnification in food chains.

46. The operators should establish efficient data management systems covering, in particular:

- a) Data processing – a plan for the collation, analysis and condensation of data. Processing should normally be carried out in stages, so that recent data are available in a detailed form and earlier data in a more summarized form;
- b) Software and statistics – details of any software packages and statistical methods used to analyse or summarize the data;

- c) Archiving – data should be systematically and securely archived, so that records of past performance are readily available.

## **B. 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 be designed to allow a smooth and possibly automated data flow from individual facilities to the competent authorities and to a publicly accessible web site. The operators should use standardized reporting formats. Public authorities should strive to 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 PUBLIC AUTHORITIES**

51. Validation of data may be more easily achievable if responsibility is delegated to competent local or regional authorities or to competent regional 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**

### **A. Establishing dialogue and optimizing costs**

54. There is a need to establish constructive dialogue between the public authorities and the operators in order to strengthen the motivation of industry to perform enterprise environmental monitoring adequately.

55. Due to the resource intensiveness of enterprise environmental monitoring, competent public authorities should consider the costs of 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 endorsing EEM programmes to take account of opportunities to improve the cost-effectiveness of enterprise monitoring.

### **B. Developing guidance and training personnel**

56. 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 facilities). They will also aim at integrating 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. 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.

### **C. Promoting environmental management systems**

57. Public authorities should help operators to establish 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. 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 peers.

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 strategy. Specific targets, goals and objectives should be integrated into the strategy which is 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. Public authorities should encourage facilities to establish EMS based on ISO 14001. Although ISO 14001 does not include a public reporting requirement, many companies publish annual company reports communicating their environmental performance to stakeholders, customers and the general public. This reporting procedure also stimulates the development of environmental reporting by facilities. The EU Eco-Management and Audit Scheme (EMAS) is another voluntary scheme which incorporates and builds on ISO 14001, but which requires participants to publish independently validated reports on performance.

60. Public authorities should launch information campaigns and training programmes to demonstrate to companies that better environmental data collection and reporting using EMS can help companies 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 cost;
- c) Improve regulatory compliance with the possibility of less frequent inspections; and
- d) Establish better relations and improved communication with public authorities, employees, shareholders and the general public.

#### **D. Corporate reporting and performance rating**

61. In order to simplify complicated systems and to transmit meaningful information about the performance of a facility, 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 and to set the framework for a methodical assessment of progress. Public authorities should encourage companies to use relevant indicators developed at the international level when reporting on their environmental performance.

62. Public authorities should encourage companies to disclose information through corporate reporting and to use relevant guidance developed at the international level to prepare corporate

environmental reports. They should also consider harmonizing, as much as possible, regulatory reporting with international benchmarks for corporate reporting.

63. For instance, the Global Reporting Initiative, a multi-stakeholder organization, is taking the lead in establishing a set of guidelines for companies wishing to report their sustainability (including environmental) performance via a set of specific indicators ([www.globalreporting.org](http://www.globalreporting.org)). The World Business Council for Sustainable Development ([www.wbcsd.ch](http://www.wbcsd.ch)) in 2000 published *Measuring Eco-Efficiency – A Guide to Reporting Company Performance*, which provides a framework for companies to measure and report on “eco-efficiency” (economic/environmental aspects of a business). Corporate Social Responsibility (CSR) is another business network ([www.csreurope.org](http://www.csreurope.org)) which encourages businesses to consider the economic, social and environmental impacts of their activities. Over 1,500 companies worldwide now produce a CSR report.

64. Competent authorities should adopt industry performance rating schemes based on enterprise environmental monitoring data or promote the use of such schemes by third parties (e.g. industry associations, insurers, banks, etc.). Performance ratings will help to simplify enterprise information to make it meaningful for the general public.