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The mission of the IHCP is to provide scientific support to the development and implementation of EU policies related to health and consumer protection.

The IHCP carries out research to improve the understanding of potential health risks posed by chemical, physical and biological agents from various sources to which consumers are exposed.

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Table of contents

1 Scope

The scope of the Ad-Hoc Working Group on Sampling and Monitoring is to give advice on selection of sampling points, sample protocols and sample frequencies in the framework of the revision of the Council Directive 98/83/EC on the quality of water intended for human consumption (Drinking Water Directive). This group was installed by the Standing Committee on Drinking Water on 8 May 2007.

This advice is prepared by members of the Standing Committee on Drinking Water. However, this document does not necessarily reflect the opinion of the Member States (MSs) they represent or that of the European Commission.

This advice is presented as a coherent set of recommendations based on the best available scientific knowledge.

2 Recommendations

Whereas the philosophy of the current Directive is acknowledged and whereas unclear issues concerning sampling and monitoring need elucidation;

Whereas the sampling procedure can influence the reported quality of water intended for human consumption;

Whereas the sampling procedure in combination with the set of parametric values can influence the protection level of the Drinking Water Directive;

Whereas MSs have developed their own sampling procedures;

Whereas reported quality of drinking water among MSs is not comparable for all parameters unless sampling procedures are harmonised;

Whereas ISO standard 5667-5 (2006) on guidance on sampling of drinking water and water used for food and beverage processing is not fully sufficient for the purpose of the Drinking Water Directive;

Whereas the introduction of a water risk management strategy in a revised Drinking Water Directive provides improved drinking water safety, especially in water supply zones where a risk management strategy is not yet implemented;

Whereas for public health reasons and for compliance purposes there is no need to monitor certain parameters, due to their origin, at the consumers' tap;

Whereas check and audit monitoring in the current Directive, meant for compliance monitoring, is not sufficient for supplying safe drinking water;

Whereas there is no legal obligation for a water supplier to set up a sampling programme for operational monitoring;

Whereas the current Directive is not clear whether hot water is intended for drinking, cooking or food preparation,

The Ad-Hoc Working Group advises the Article 12 Standing Committee on Drinking Water to include the following set of recommendations into the revised Drinking Water Directive:

2.1 Definitions

1) During the discussions in the Group it appeared to be necessary to clearly define some terms mentioned in the current Directive and to introduce new terms and their definitions. The following definitions of existing terms in the current Directive should be added to Art. 2:

   Distribution network comprises all fixtures and products in contact with drinking water such as reservoirs, pipes and fittings which are installed between the ***point of exit***(s) and the ***point of entry***. (Art. 2, 6 and Table B1 in Annex III)

   Point of compliance is the point within premises or an establishment at which water emerges from the tap where the water is normally used for human consumption. For compliance sampling purposes and practical reasons this is normally the cold water tap in the kitchen. (Art. 6)

   "supplied to the public" means all water supplied in public and private premises, indoor or outdoor, and all water supplied during public and commercial activities where the public can enter or participate. A non-extensive list of such premises comprises schools, hospitals, hotels, restaurants, companies, factories, sports centres, premises for rent, fountains when "not for potable use" is not indicated, etc. (Art. 6)

   Water supplier is one or more organisations that distribute water intended for human consumption. (Art. 2)

Water supply zone is a geographically defined area within which water intended for human consumption comes from one or more sources and within which water quality may be considered as being approximately uniform. (Note 1 of Table B1 in Annex III)

The following definitions of new terms should be added to Art. 2 of the current Directive:

Compliance monitoring is the monitoring specified by the Directive at the point of compliance to verify that water supplied for human consumption is in compliance with its quality requirements and the results are subject to its reporting requirements.

Operational monitoring is the monitoring activity to check the quality of source water, and to validate the operation of the water treatment plant, the ***distribution network*** and the ***domestic distribution system*** up to the tap. The results of ***operational monitoring*** are not subject to the reporting requirements of the Directive.

Point of entry is that point in the distribution network where the water enters the premise, public or private. In certain cases it is equivalent to the ***point of supply***.

Point of exit is that point where the water leaves the water treatment plant or point of abstraction where there is no treatment.

Point of supply is that point in the distribution network where the responsibility of the water supplier ends and the responsibility of the property owner for the internal plumbing system starts. The exact definition of point of supply should be defined in national law. Examples of point of supply are the water meter or the stopcock at a premises' border (or curtilage). In certain cases it is equivalent to the ***point of entry***.

2.2 Compliance monitoring

2) Annex II Table B1 of the current Directive states that "in the case of a distribution network, a MS may take samples within the supply zone or at the treatment works for particular parameters if it can be demonstrated that there would be no adverse change to the measured value of the parameters concerned". The Group considered that this phrase is open to too wide an interpretation and does not contribute to a comparable demonstration of the quality and safety of drinking water among MSs. The Group recommends clarification of the current Directive on this issue and implementation of Table 1 (see Annex 1) that specifies which parameters of Annex I of the current Directive can be sampled at alternative points for compliance monitoring. Should additional parameters be proposed by the Expert Group on Microbiology or the consortium of experts on the chemical parameters, the table will require review.

3) In Art. 2 and 6 of the current Directive the expression "taps that are normally used for human consumption" is used. The Group considered that this expression is not clear enough in the scope of sampling and monitoring. The interpretation of some MSs is that hot water is not covered by the current Directive, other MSs consider hot water to be covered, but practically do not monitor the quality of hot water and other MSs consider hot water to be fully covered. The different interpretations are caused by the open definition of "water intended for human consumption" (Art. 2) specifically that it is intended for "other domestic purposes" suggesting exposure from washing and inhaling (e.g. showering). The Group considered that the major exposure route for "water intended for human consumption" is through drinking, cooking and food preparation. Therefore the Group recommends that compliance samples from the consumers' tap should be taken from that "cold water tap that is normally used for human consumption".

4) Samples of water taken at the consumers tap may be influenced by the condition of the tap and the premise's plumbing system. This should not be the case when samples are taken in the distribution network where the sampling taps should not influence the results of the compliance monitoring. The revised Directive should include a paragraph on the criteria for sampling taps in the distribution network and how to take samples at those taps. The Group recommends that sampling taps in the distribution network should follow the general design guidelines mentioned in standard ISO 5667-5 (2006). Before taking compliance samples for microbiological parameters taps should be disinfected and flushed to allow stagnant water in the tap and sampling line to flow out and to remove disinfectants (see paragraph 5 below for

further explanation). For compliance sampling of other parameters, the sampling line need only to be flushed. To ensure that the sample is representative of the local distribution network the Group recommends that the sampling line is flushed to discharge three times the total volume of the sampling line with the tap fully open. Monitoring the temperature to stabilisation of the flushed water is an alternative method to establish when the sampling line is flushed when the water from the distribution network is cooler than the ambient temperature.

5) The current Directive states in Art. 7 that "samples should be taken so that they are representative of the quality of the water consumed throughout the year". This is very difficult to realise for parameters which are potentially influenced by the domestic distribution system, e.g. microbiological parameters and certain metals and in view of the possibility that there is only one sample required to be taken for compliance purposes per year. A consumer's pattern of water use determines their exposure and a representative sample for an individual consumer or a group of consumers is difficult to obtain. The Group considered that the Directive should be more specific on the sampling protocols for various parameters. The Group recommends a monitoring protocol based on five sampling routines and three groups of parameters, i.e. microbiological parameters, metals dissolving from plumbing materials and other parameters. These sampling methods are summarised in Table 2 in Annex 1.

   a) ***Microbiological parameters*** – Standard ISO 19458 distinguishes three sampling methods at the consumers' tap. Method A has the purpose to check the quality of the water in the distribution network, Method B to check the quality as it is delivered to the tap and method C to check the quality as it is consumed. Method A has the disadvantage that it does not give information about the potential contribution from survival or re-growth in the domestic distribution system. The advantage of method A is that the sampling method gives harmonised results and shows the likely quality of water delivered to the majority of the population within a water supply zone. Method B has the advantage that it includes potential contribution from survival or re-growth in the domestic distribution system. The disadvantage of method B is that the sampling method does not give harmonised results due to the fact that a minimal flushing is necessary to overcome effects of disinfecting the tap and it may only provide results representative of the quality of water at that particular domestic installation. Method C approaches very near to the requirements of Art. 7 of the current Directive. However the disadvantage of method C is that the results are potentially influenced by the external conditions of the individual tap used for sampling and again may only provide results representative of the quality of water at that particular domestic installation, not to the population as a whole. After long intensive discussions the Group decided that the most important criteria for selecting the sampling method are: i) the sample should be taken in a way that it demonstrates the water quality received by the majority of the population in a water supply zone; and ii) the sample method should give harmonised results for compliance. Therefore the Group recommends that compliance samples for microbiological parameters should be taken at the consumers' tap according to ISO 19458 purpose A using a sufficient volume of water for flushing after removal of attached devices and disinfection of the tap. Selection of purpose A indicates that the compliance sample for microbiological parameters could also be taken at the point of supply according to recommendation 4) above, if suitable sampling facilities are available, because the result of this way of sampling will be similar to that obtained by sampling at the consumers' tap with sufficient prior flushing.

   b) ***Metals dissolving from plumbing materials*** – Note 3 of Part B of Annex I of the current Directive states that "the value (for copper lead and nickel) applies to a sample of water intended for human consumption obtained by an adequate sampling method (to be added following the outcome of the study "Developing a new protocol for the monitoring of lead in drinking water"; EUR 19087 EN (1999)) at the tap and taken so as to be representative of a weekly average value ingested by consumers. Where appropriate the sampling and monitoring methods must be applied in a harmonised fashion to be drawn up in accordance with Article 7(4). MSs must take account of the occurrence of peak levels that may cause adverse effects on human health". The implementation of this note into practical sampling and monitoring schemes has not been solved by the MSs. The outcome of the mentioned lead sampling study was that in terms of costs, practicality and consumer acceptance the random day time sampling protocol is the most favourable. Random daytime sampling means that a sample of one litre is taken without prior flushing at a random time during a normal working day. Although the reproducibility of random day time

sampling is poor, the study concluded that it is the most practicable and representative method for compliance purposes. The study showed that the random daytime method was capable of detecting about 80% of the properties that exceeded the parametric value of 10 µg/l obtained by proportional sampling. However, the random day time sampling protocol is not capable of detecting about 20% of the non-complying properties and the question is whether we accept this protection level. In addition, about 60% of the data showed a difference between the concentrations of lead random day time and proportional sampling of more than 25%. The concentration of metals obtained by using the random day time sampling method cannot be considered capable of providing results representative of the weekly average value because this will vary for each consumer depending on the composition of the local distribution network and domestic distribution systems. Compliance monitoring at the required minimum frequency will never provide the required protection for lead, copper and nickel. This has to be done through the Water Risk Management Strategy and special sampling surveys.

Apart from copper, lead and nickel there are also other parameters listed in Part C of Annex I of the current Directive that have their major potential source from the materials in the domestic distribution system. The Group recommends that antimony, cadmium and chromium should be sampled using the same method as that recommended for copper lead and nickel.

In the absence of a practical sampling protocol that represents the weekly average value, the Group recommends that compliance samples for antimony, cadmium, chromium, copper, lead and nickel should be taken at the consumers' tap by random daytime sampling meaning that a sample of one litre is taken without prior flushing at a random time during a normal working day. Since this sampling protocol is not capable of representing a weekly average value, the Group recommends that the Art. 12 Standing Committee on Drinking Water reviews the special sampling requirement to obtain a sample that is representative of the weekly average value ingested. In addition the Group decided to make other recommendations related to materials used in the domestic distribution system (see 14), 14)b) and 14)b)).

c) ***Remaining parameters*** – The Group recommends that compliance samples for the other parameters should be taken at the sampling points indicated in Table 1 of Annex 1. Samples taken from a tap at the point of exit and the point of supply should be taken according to recommendation 4). Samples are taken at the consumers' tap can be taken without flushing.

5) Article 7 requires MSs to establish a monitoring programme which confirms the arrangements for sampling and analysis. Art. 7.2 states "to meet the obligations imposed in paragraph 1, appropriate monitoring programmes shall be established by the competent authorities for all water intended for human consumption. Those monitoring programmes shall meet the minimum requirements set out in Annex II". Art. 7.3 states "the sampling points shall be determined by the competent authorities and shall meet the relevant requirements set out in Annex II. The Group is of the opinion that Art. 7 should be more specific in order to harmonise the sampling programmes for compliance monitoring among MSs. A text, like the following, could be incorporated: "The sampling programme for compliance monitoring should define sampling dates and sampling points on that date, and specify which parameters are to be analysed in each sample. Where the sampling requirement is for less than one sample per day sampling dates should be selected randomly, but the sampling programme should also ensure that the sampling dates are spread through the year. All premises within a water supply zone, whether public or private, should be included in the compliance sampling programme. MSs may exclude private wells that supply up to 10 m^3 per day, from compliance monitoring.

   Art. 7.4 states "community guidelines for the monitoring prescribed in this Article may be drawn up in accordance with the procedure laid down in Article 12". Many MSs already have detailed monitoring procedures for their water suppliers and the Group saw no value in spending time duplicating this work in the detail that is required for monitoring purposes. Therefore Art. 7.4 could be deleted.

6) The Group reviewed Annex II on monitoring in the current Directive. Four particular issues were considered: a) the introduction of a risk management strategy for all water supplies from

catchment to tap; b) current terminology; c) parameter frequency; d) the need for greater focus and information on the quality of small water supplies, i.e. those supplying ≤1000 m^3/day.

a) The risk management strategy will place much more emphasis on risk assessment and reduction in the source water catchment and through treatment and distribution. The strategy recognises that there is a need for compliance monitoring to verify to regulatory authorities that the risk management approach is consistently producing water that meets the requirements of the Directive at the consumers' tap. However, compliance monitoring is not meant to guarantee the safety of the water supply. This will be achieved through validation and control of risk reduction measures from catchment to tap and demonstrated through focused, risk determined operational monitoring (see later).

b) Compliance monitoring in the current directive distinguishes check and audit monitoring. The Group was strongly of the opinion that the current Directive terms of check and audit monitoring and their explanations are not entirely clear and have led to confusion. However, it is also their view that there will continue to be a requirement for compliance monitoring for some parameters to be at a higher frequency than for the majority. The Group recommends the straightforward terms of standard and enhanced monitoring be used in a revised Directive.

c) Minimum sampling frequencies for compliance monitoring are proposed in Table 3 of Annex 2 In the event of intermittent short-term supply the compliance monitoring frequency of water distributed by tankers or seasonal water supplies is to be decided by the MS concerned. The actual frequencies decided should take account of the water risk management strategy. The frequency for sampling any additional parameter that may be proposed by the Expert Group on Microbiology or the consortium of experts on the chemical parameters should be evaluated at a later stage.

   Parameters to be included for enhanced compliance monitoring are those related to microbiological safety and, if used, disinfection efficacy (*E. coli*, Enterococci, coliform bacteria, colony count 22°C, colony count 37°C, *C. perfringens*), general hygienic parameters (colour, conductivity, odour, pH, taste, turbidity), metal parameters related to domestic plumbing installations (antimony, cadmium, chromium, copper, lead, nickel) and some substances that are used in or affected by water treatment (aluminium, iron, ammonium, nitrite). Inclusion of the metals is a new recommendation but this is an area that requires attention and may not be well covered by operational monitoring. The Group has tentatively included coliform bacteria, colony counts and *Clostridium perfringens* for enhanced monitoring but expects the advice from the Expert Group on Microbiology to clarify or amend these requirements. The consortium of experts on the chemical parameters may recommend revision of the list of compliance parameters.

d) For supply zones where the volume of water distributed is greater than 1000 m^3/day, the proposed annual standard sampling frequency is identical to the current Directive's audit frequency.

   The Group recommends a significant increase in enhanced compliance monitoring for water supply zones >100-1000 m^3/day, i.e. from 4 to 12 samples per year and a smaller significant increase for water supply zones >1000-2000 m^3/day, i.e. from 10 to 12 samples per year. For water supply zones >2000 m^3/day the enhanced monitoring frequency reduces by one sample per year compared to the current check monitoring. This is due to a mathematical fact that the enhanced monitoring frequencies could not be fitted to the current check monitoring with a simple formula assuming the increase of enhanced monitoring for water supply zones >100-1000 m^3/day.

   The Group recognises that the risk management strategy will have the greatest influence in achieving improvements in the safety of water supplies of ≤100 m^3/day but recommends compliance monitoring requirements be extended to all supplies. The Group recommends keeping Art. 3.2(b) on the possible exemption of water supplies serving ≤10 m^3/day and not serving commercial and public activities. The Group also recommends that all supplies subject to compliance monitoring be included in a revised Directive's reporting requirements. This is to enable the Commission and other regulatory bodies to gain a better understanding of the quality of small supplies and the extent of their compliance with Directive requirements and to better report to the public on this issue. The Group is of the opinion that the frequencies for compliance monitoring set out in Table 2 of Annex 2 are a

minimum requirement and that the real compliance frequencies should depend on the risk assessment made in the water risk management strategy.

7) Note 4 of Table B1 in Annex II of the current Directive states for check monitoring that "for the different parameters in Annex I, a MS may reduce the number of samples specified in the table if (a) the values of the results obtained from samples taken during a period of at least two successive years are constant and significantly better than the limits laid down in Annex I, and (b) no factor is likely to cause a deterioration of the quality of the water. The lowest frequency applied must not be less than 50 % of the number of samples specified in the table". The Group considers that such reduction should not be valid only for enhanced monitoring but also for standard monitoring. The Group recommends revision of the reduction rules for compliance monitoring: For the different parameters in Table 3 of Annex 2, a MS may reduce the number of compliance samples specified in the table if the values of the results obtained from samples taken during a period of at least two successive years are constant or reducing and no factor is likely to cause a deterioration of the quality of the water by this parameter in the water risk management strategy.

   a. The frequency for microbiological parameters cannot be reduced;

   b. For arsenic, boron, cyanide, fluoride, mercury, aluminium, ammonium, chloride, sulphate and sodium, that have a concentration below half of the parametric value in the source water and that originate from geological sources, the lowest frequency applied must not be less than 10% of the number of samples specified in Table 3 of Annex 2 with a minimum frequency of one sample per year;

   c. For the remaining parameters, that have a concentration below half of the parametric value at the sampling point for compliance monitoring (see Table 1 of Annex 1) and that originate from non-geological sources, the lowest frequency applied must not be less than 50% of the number of samples specified in Table 3 of Annex 2 with a minimum frequency of one sample per year.

8) The current Directive gives two options to reduce the number of parameters to be monitored for compliance:

   - Art. 3.2(b) states "MSs may exempt from the provisions of this Directive: … (b) water intended for human consumption from an individual supply providing less than 10 m³ a day as an average or serving fewer than 50 persons, unless the water is supplied as part of a commercial or public activity".

   - The paragraph on audit monitoring in Table A of Annex II states that "All parameters set in accordance with Article 5(2) and (3) must be subject to audit monitoring unless it can be established by the competent authorities, for a period of time to be determined by them, that a parameter is not likely to be present in a given supply in concentrations which could lead to the risk of a breach of the relevant parametric value". The Group recommends this statement be clarified through guidance.

   The Group recommends:

   a) keeping Art. 3.2(b) on the possible exemption of water supplies serving ≤10 m^3/day and not serving commercial and public activities.

   b) Changing the paragraph on audit monitoring in Table A of Annex II in: "All parameters must be subject to compliance monitoring unless it can be established by the competent authorities based on the water risk management strategy, that, for a period of time to be determined by them, a parameter is not likely to be present in a given supply zone in concentrations which could lead to the risk of a breach of the relevant parametric value"

2.3 Investigation of non-compliance due to domestic distribution systems

9) Non-compliance in the case Art 6.2 of the current Directive should be investigated. Approaches for investigation of non-compliance of copper, lead and nickel are given in Annex III of the Draft COMMISSION DECISION of [...] defining an adequate sampling method for Lead, Copper and

Nickel, monitoring requirements for the parameters for radioactivity and guidelines for the monitoring the quality of water intended for human consumption for the Council Directive 98/83 of 3 November 1998 on the quality of water intended for human consumption (2005).

10) It is necessary to have a clear definition for non-compliance of metals at an individual tap in order to establish that the non-compliance as a result of the random daytime sample is due to the domestic distribution system. Germany uses a four-hour stagnation time assuming that 97% of the households have a proportional stagnation lower than four hours. Other MSs state that four-hour stagnation is not practical and use 30 min stagnation. However the Lead Sampling Study mentioned in 4)b) shows that the 30 minute stagnation method is not detecting the properties that exceeded the parametric value of 10 µg/l obtained by proportional sampling better than the random daytime sampling method. The Group recommends the Standing Committee on Drinking Water to consider this issue in further detail so that individual EU consumers will have a similar protection level.

2.4 Water risk management strategy

11) The revised Directive should include an obligation on MSs to ensure that a water risk management strategy is prepared for each of their water supply zones including water source(s), treatment, distribution network and domestic distribution systems. Among other issues, the water risk management strategy should

    a) Identify all current and potential hazards that can affect the safety of water from the catchment, through treatment and distribution and within consumer premises,

    b) Assess the risk associated with each identified hazard and the control, barrier or mitigation measures in place,

    c) Identify the gaps where controls, barriers or mitigation are not present and are required to protect the safety of the water supply.

    d) Take measures to reduce the risk by implementing improvement programmes to put controls, barriers and mitigation measures in place.

    Monitoring for investigation of risk, validation and operational purposes is a very important element of a water risk management strategy. Each water risk management strategy needs to be kept up to date, reviewed regularly and be subject to regular external audit.

12) Compliance monitoring aims to verify to regulatory authorities that the risk management approach is consistently producing water that meets the requirements of the Directive at the consumers' tap and is not meant to guarantee the safety of the water supply. The water risk management strategy foresees operational monitoring as the tool for: demonstrating and understanding the quality of the raw water; validating and demonstrating the continuing efficacy of the treatment system; and demonstrating the integrity of the distribution systems in achieving and ensuring the safety of a water supply. Operational monitoring is a matter for MSs and their water suppliers and the details of operational monitoring should remain outside the scope of the Drinking Water Directive but the risk management approach will require its parameters and frequencies to be reviewed and in some cases improved. It may need to include parameters not listed in the Directive. For most supplies operational monitoring certainly needs to be at a much greater frequency than the current requirements for check monitoring and for some parameters and disinfectant residuals will be best achieved through automated continuous monitoring. Although the Group has decided not to specifically recommend critical control points such as the exit from water treatment works and the exit from service reservoirs as compliance sampling points, it would expect these points to be covered by operational monitoring. The Group recommends the inclusion of some general wording on operational monitoring be included in the revised Directive, e.g.: "The sampling programme for operational monitoring should be tailor made for each water supply reflecting the risks identified in the water risk management strategy. The locations of sampling points, the parameters and the frequency of sampling depend on the risks and controls within the catchment area, the treatment process, the distribution network and domestic distribution systems".

13) Since operational monitoring is part of the water risk management strategy which will become part of the revised Directive, the Group recommends the inclusion of a statement in Annex III

on the specifications for the analysis of parameters: “MSs should aim at a Quality Assurance Scheme for operational monitoring that is at a similar level as required for compliance monitoring”.

14) The influence of the domestic distribution system on the quality of tap water and on consumers’ exposure is rather unpredictable due to the individual circumstances of the pipe work and water usage at each premise. In order to reduce the risk to consumers of exposure to levels of certain parameters that represent a danger to health, the Group recommends the inclusion of three clauses in the revised Directive:

    a) The revised Directive should include an obligation on MSs to pay special attention to assess the risk of release of metals due to materials in the domestic distribution system as part of the water risk management strategy and to propose programmes reducing such release. Special attention should be given to lead.

    b) The revised Directive should include an obligation on MSs to inform consumers that for the purpose of protecting public health, appropriate products are on the market to construct their private domestic distribution system.

    c) The revised Directive should include a strong recommendation to MSs to inform consumers that for the purpose of protecting public health consumers are advised to flush their tap prior to using the water for consumption when it has been standing stagnant in the domestic distribution system. Consumers should be advised to collect the flushed water and use it for other purposes.

3 Advice on aspects related to sampling and monitoring

The scope of the Ad-Hoc Working Group on Sampling for Compliance Monitoring is to give advice on selection of sampling points, sample protocols and sample frequencies in the framework of the revision of the Council Directive 98/83/EC on the quality of water intended for human consumption (Drinking Water Directive). The Group considered that it would be beneficial to provide also advice on important sampling and monitoring related issues for the revision of the Directive.

The Ad-Hoc Working Group advises the Article 12 Standing Committee on Drinking Water to discuss the following sampling related recommendations in the revision process of the Drinking Water Directive:

a. Removal of acrylamide, epichlorohydrin and vinyl chloride from the list of parameters in Part B of Annex I of the current Directive. These parameters are a very small selection of substances that can potentially migrate from materials in contact with drinking water. These three parameters need consideration within the revision of article 10 of the current Directive. If it is decided that these parameters are not removed, at least the calculation methodology of the maximum release to water should be specified in note 1 in Part B of Annex I of the current Directive. If vinyl chloride is deleted from the list of parameters, it should be noted that contamination by vinyl chloride may occur from sources other than migration from materials; this aspect is considered to be part of the water risk management strategy.

b. Review the special sampling requirement to obtain a sample that is representative of the "weekly average value ingested" for copper, lead and nickel. Practice of the current Directive has shown that there are practical and legal problems in interpreting the term "weekly average value ingested" mentioned in note 3 of Part B in Annex I of the current Directive in relation to sampling procedures. The Group advises to reconsider the concept of "weekly average value ingested".

c. The Group identified several items for clarification.

    1. Whether hot water should not be within the scope of the revision of the Directive and whether it should be monitored

    2. Whether water supplied in trains, ships, planes etc. should not be in the scope of the Directive

    3. The definition of (very) small water supplies, differentiation between public and private (very) small water supplies and whether they should be kept under the Directive and the reporting requirements

    4. The legal requirements for monitoring colony count at 22°C and 37°C in tap water and water intended to be bottled. This aspect should be considered by Legal Service of the Commission.

    5. The reporting format should allow clarifying the cause of non-compliance of a sample, especially for failure of the domestic distribution system

    6. The status of sampling and monitoring of tritium and total indicative dose proposed in the Draft COMMISSION DECISION of [...] defining an adequate sampling method for Lead, Copper and Nickel, monitoring requirements for the parameters for radioactivity and guidelines for the monitoring the quality of water intended for human consumption for the Council Directive 98/83 of 3 November 1998 on the quality of water intended for human consumption (2005)

    7. Performance characteristics of the analysis in Annex III of the current Directive

    8. The use of the same dimension of units, e.g. not mixing mg/l or µg/l.

    9. The legal status of notes in an Annex of the revised Directive. This important for deciding whether recommendations for the revision should be in an Article or can remain in a note.

4 References

1 **EC; Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption; *Official Journal of the European Communities* L 330, 32-54 (1998)**

2 **EC, Draft COMMISSION DECISION of [...] defining an adequate sampling method for Lead, Copper and Nickel, monitoring requirements for the parameters for radioactivity and guidelines for the monitoring the quality of water intended for human consumption for the Council Directive 98/83 of 3 November 1998 on the quality of water intended for human consumption (2005)**

3 **ISO 5667-5; Water Quality – Sampling – Part 5: Guidance on sampling of drinking water from treatment works and piped distribution systems, 2nd ed. (2006)**

4 **Van den Hoven Th.J.J., Buijs P.J., Jackson P.J., Miller S., Gardner M., Leroy P., Baron J., Boireau A., Cordonnier J., Wagner I., Marecos do Monte H., Benoliel M.J., Papadopoulos I., Quevauviller Ph.; Developing a new protocol for the monitoring of lead in drinking water; European Commission, BCR Information, Chemical Analysis, EUR 19087 EN (1999)**

5 Annex 1 Sampling points and sampling methods for compliance monitoring

Table 1 Points where parameters of Annex I of the current Directive can be sampled for compliance monitoring

Parameter	Point of exit [1]	Point of supply [1]	Consumers' tap	Note
E. coli		√	√	2
Enterococci		√	√	2
Acrylamide				3
Antimony			√	4
Arsenic	√	√	√	5
Benzene	√	√	√	6
Benzo(a)pyrene		√	√	
Boron	√	√	√	
Bromate	√	√	√	7
Cadmium			√	4
Chromium			√	4
Copper			√	4
Cyanide	√	√	√	
1,2-dichlororethane	√	√	√	6
Epichlorohydrin				3
Fluoride	√	√	√	
Lead			√	4
Mercury	√	√	√	
Nickel			√	4
Nitrate			√	5, 8
Nitrite			√	5, 8
Pesticides, single	√	√	√	
Pesticides, total	√	√	√	
PAH		√	√	
Selenium	√	√	√	
Tetrachloroethane, Trichloroethane	√	√	√	6
THM, total		√	√	6, 9
Vinylchloride	√	√	√	3, 6, 10
Aluminium	√	√	√	7
Ammonium	√	√	√	7
Chloride	√	√	√	
C. perfringens	√	√	√	2, 11
Colour		√	√	
Conductivity		√	√	
pH		√	√	
Iron		√	√	
Manganese		√	√	
Odour		√	√	
Oxidisability		√	√	
Sulphate	√	√	√	7
Sodium	√	√	√	7
Taste		√	√	
Colony count 22°C		√	√	2, 11
Colony count 37°C		√	√	2, 11
Coliform bacteria		√	√	2, 11
TOC		√	√	
Turbidity		√	√	12
Tritium	√	√	√	13
Total indicative dose	√	√	√	13

1 **Sampling taps in the distribution network with the exception of the consumers' tap should follow the general design guidelines of ISO 5667-5 (2006). Sampling taps in the distribution network should be disinfected before taking samples for microbiological parameters and flushed to allow stagnant water in the tap and sampling line to flow out and to remove disinfectants. For other parameters sampling taps in the distribution network should only be flushed. Flushing for three times the total volume of sampling line and tap with the tap fully open should be sufficient. Monitoring the temperature stabilisation of the flushed water is an alternative when the water from the distribution network is cooler than the ambient temperature.**

2 **Compliance samples for microbiological parameters should be taken at i) the consumers' tap according to ISO 19458 for purpose A "in the distribution network" using a sufficient volume of water for flushing after removal of attached devices and disinfection of the tap or ii) the point of supply (see note 1).**

3 **Compliance is demonstrated via product specification, but measurement is needed at an appropriate sampling point if the risk assessment shows a need**

4 **Compliance samples for antimony, cadmium, chromium, copper, lead and nickel should be taken at the consumers' tap by random daytime sampling meaning that a sample of one litre is taken without prior flushing at a random time during a working day at office hours.**

5 **Selection of the sampling point depends on risk assessment taking into account the various sources, e.g. arsenic from raw water and materials in contact with drinking water and nitrite/nitrate from raw water and degradation of precursors in the water supply zone.**

6 **Sampling should take place at point of supply or consumers' tap when plastic distribution network components are embedded in soil for which the risk assessment indicates a potential for contamination with benzene, 1,2-dichloroethane, tetrachloroethene, trichloroethene, chloroform and vinylchloride.**

7 **Sampling must take place at the consumers' tap when i) ozone disinfection (potential bromate formation) is used in the distribution network or domestic distribution system, ii) aluminium substances are used in the water treatment plant, distribution network or domestic distribution system and iii) relevant treatment, e.g. chloramination or softening, is used between the point of exit and consumers' tap**

8 **Sampling should take place at point of exit and the consumers' tap. For demonstrating compliance with the formula, the analysis of nitrate and nitrite should be done in the same sample**

9 **Sampling can be restricted to the point of exit when the risk assessment combined with a stricter parametric value provides a similar level of protection. Sampling must take place at the consumers' tap when additional chlorine disinfection (potential THM formation) is used in the distribution network or domestic distribution system**

10 **Sampling is recommended at point of exit when risk assessment shows that chlorinated hydrocarbon precursors of vinyl chloride are potentially present in the raw water**

11 **Advice of the Expert Group on Microbiology is not to use coliforms, *Clostridium perfringens*, colony count 22°C and colony count 37°C for compliance monitoring (17-18 Oct. 2007 and 27-28 Feb. 2008). If *Clostridium perfringens* remains in the revised Directive, there should be a statement under which conditions water needs to be sampled for this parameter. If colony count 22°C and colony count 37°C remain in the revised Directive, their legal status (bottled drinking water or all drinking water) should be clarified.**

12 **Sampling should also take place at point of exit in the case of surface water is used for drinking water production**

13 Monitoring strategy still to be agreed. Water risk management strategy approach will put more emphasis on risk assessment

Table 2 Overview of sampling methods and requirements for the various parameters at the different points for compliance sampling. Sampling methods may be different considering the notes in Table 1 of Annex 1

Parameter	Point of exit	Point of supply	Consumers' tap
Antimony, cadmium, chromium, copper, lead and nickel	n.a.	n.a.	random daytime sampling
Nitrate, nitrite	n.a.	n.a.	No tap flushing
Microbiological parameters	n.a.	Disinfected tap and flushed sampling line	ISO 19458 for purpose A
Benzo(a)pyrene, PAH, THM, colour, conductivity, pH, iron, manganese, odour, oxidisability, taste, TOC, turbidity	n.a.	Flushed sampling line	No tap flushing
Other parameters	Flushed sampling line	Flushed sampling line	No tap flushing

n.a., not applicable

6 Annex 2 Sampling frequencies for compliance monitoring

Table 3 Minimum sampling frequencies for compliance monitoring in a water supply zone

Volume of water distributed [2]	Number of compliance samples	
	Enhanced frequency [3]	Standard frequency [4]
m^3/day	n/year	n/year
≤ 10	1 [1]	1 [1]
> 10 − ≤ 100	4	1
> 100 − ≤ 1000	12	1
> 1000 – ≤ 3000		1 + 1 for each 3300 m^3/day and part thereof of the total volume
> 3000 − ≤ 10,000	12 + 3 for each 1000 m^3/day and part thereof of (Volume minus 3000)	
> 10,000 − ≤ 100,000		3 + 1 for each 10,000 m^3/day and part thereof of the total volume
> 100,000		10 + 1 for each 25,000 m^3/day and part thereof of the total volume

1 Minimum frequencies for compliance monitoring should depend on the risk assessment made in the water risk management strategy and could be higher

2 The volumes are calculated as averages taken over a calendar year. A MS may use the number of inhabitants in a water supply zone instead of the volume of water to determine the minimum frequency, assuming a water consumption of 200 l/day/capita.

3 Enhanced frequency applies to *E. coli*, Enterococci, coliform, colony count 22°C, colony count 37°C, *C. perfringens,* antimony, cadmium, chromium, copper, lead, nickel, colour, conductivity, odour, pH, taste, turbidity (see also note 11 of Table 1)

These enhanced frequencies also apply for aluminium and iron when they are present in flocculants used, for ammonium when precursors are formed during water treatment and for nitrite when chloramination is used as disinfection

4 Standard frequency applies to parameters not mentioned in note 3. Sampling frequencies for tritium and total indicative dose are excluded

Table **4** compares the parameters for check and audit monitoring in the current Directive with those proposed for enhanced and standard frequency compliance monitoring. Table 5 sets out for illustrative purposes the current and proposed sampling frequencies for seven example water supply zones with populations ranging from 45 to 650,000 people. Figure 1 to Figure 4 also illustrate the existing and proposed sampling frequencies in graphical form. It must be emphasised that the Group's recommendations relate to minimum compliance monitoring frequencies where appropriate and MSs are free to set additional or more stringent requirements.

Table 4 Comparison of minimum sampling frequencies for compliance monitoring between current and revised Directive

Parameter	Current	Revised	Current	Revised
	Check	Enhanced	Audit	Standard
E. coli	√	√		
Enterococci		√	√	
Acrylamide				
Antimony		√	√	
Arsenic			√	√
Benzene			√	√
Benzo(a)pyrene			√	√
Boron			√	√
Bromate			√	√
Cadmium		√	√	
Chromium		√	√	
Copper		√	√	
Cyanide			√	√
1,2-dichlororethane			√	√
Epichlorohydrin				
Fluoride			√	√
Lead		√	√	
Mercury			√	√
Nickel		√	√	
Nitrate			√	√
Nitrite	√	√ [3]		√
Pesticides, single			√	√
Pesticides, total			√	√
PAH			√	√
Selenium			√	√
Tetrachloroethane, Trichloroethane			√	√
THM, total			√	√
Vinylchloride			√	√
Aluminium	√	√ [3]		√
Ammonium	√	√ [3]		√
Chloride			√	√
C. perfringens	√	√ [3,11]		
Colour	√	√		
Conductivity	√	√		
pH	√	√		
Iron	√	√ [3]		√
Manganese			√	√
Odour	√	√		
Oxidisability			√	√
Sulphate			√	√
Sodium			√	√
Taste	√	√		
Colony count 22°C	√	√ [3,11]		
Colony count 37°C)	√	√ [3,11]		
Coliform bacteria	√	√ [3,11]		
TOC			√	√
Turbidity	√	√		
Tritium			√	√
Total indicative dose			√	√

Note 3 refers to that of Table 3 and Note 11 refers to that in Table 1.

Table 5 **Comparison of current and proposed minimum sampling frequencies for compliance in example water supply zones**

Example Water Supply Zone Population	Volume of water distributed (m^3/d)	Current Annual Check Frequency	Proposed Annual Enhanced Frequency	Current Annual Audit Frequency	Proposed Annual Standard Frequency
A 45	9	*	1	*	1
B 430	86	*	4	*	1
C 850	170	4	12	1	1
D 9,370	1,854	10	12	2	2
E 87,500	17,500	58	57	5	5
F 217,000	43,400	136	135	8	8
G 650,000	130,000	394	393	16	16

*The frequency is to be decided by the MS concerned

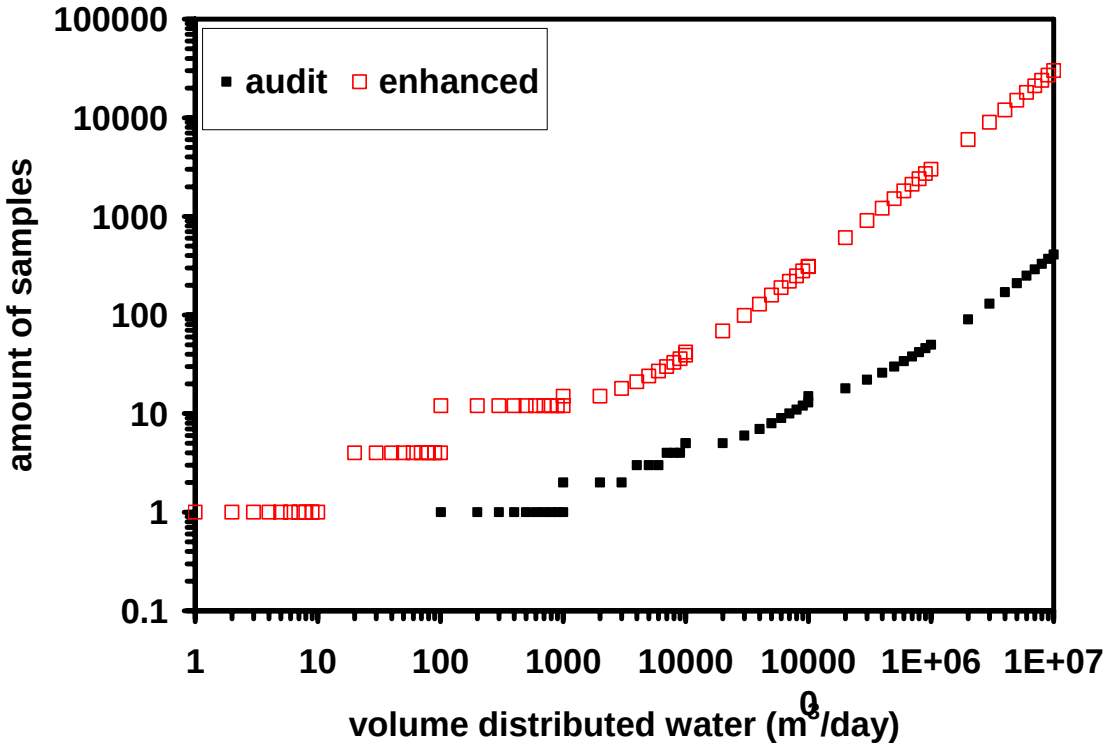

Figure 1 **The minimum sampling frequency of Enterococci, antimony, cadmium, chromium, copper, lead and nickel will be increased**

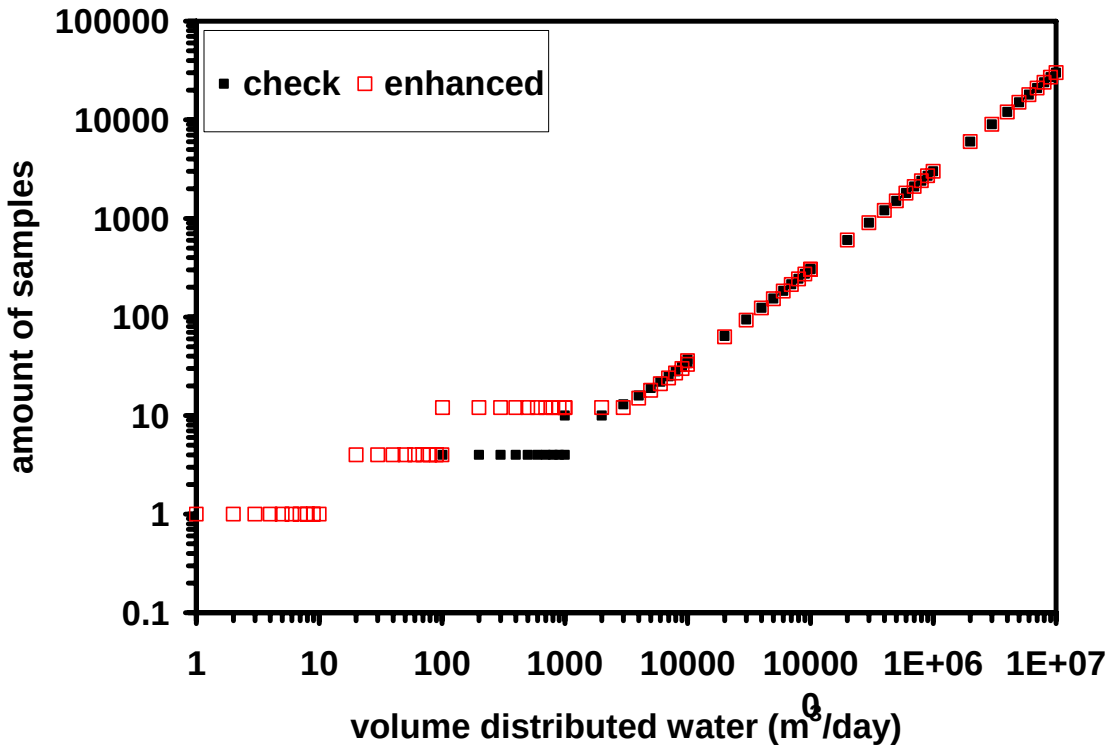

Figure 2 **The minimum sampling frequency of E. coli, coliform, colony count 22°C, colony count 37°C, *C. perfringens*, colour, conductivity, pH, odour, taste and turbidity will generally increase for average production volumes smaller than 10,000 m^3/day. This is also the case for the minimum sampling frequency of aluminium, ammonium, iron and nitrite complying with note 3 of Table 3 in Annex 2**

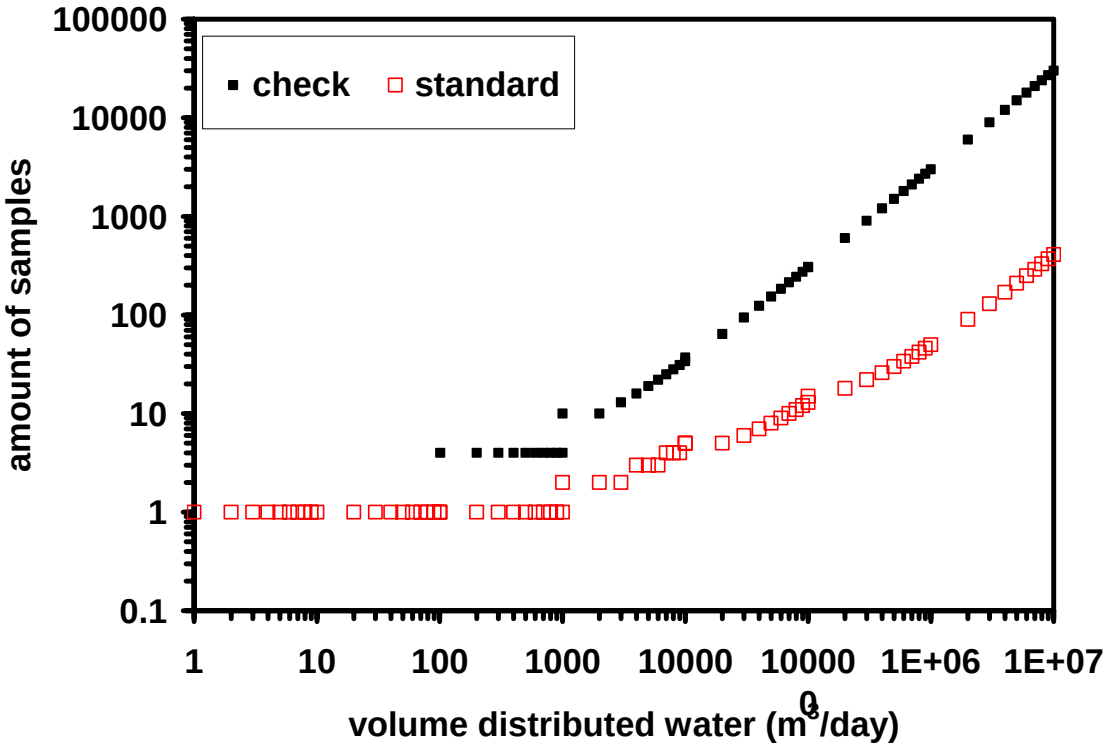

Figure 3 **The minimum sampling frequency of aluminium, ammonium, iron and nitrite not complying with note 3 of Table 3 in Annex 2 will be reduced**

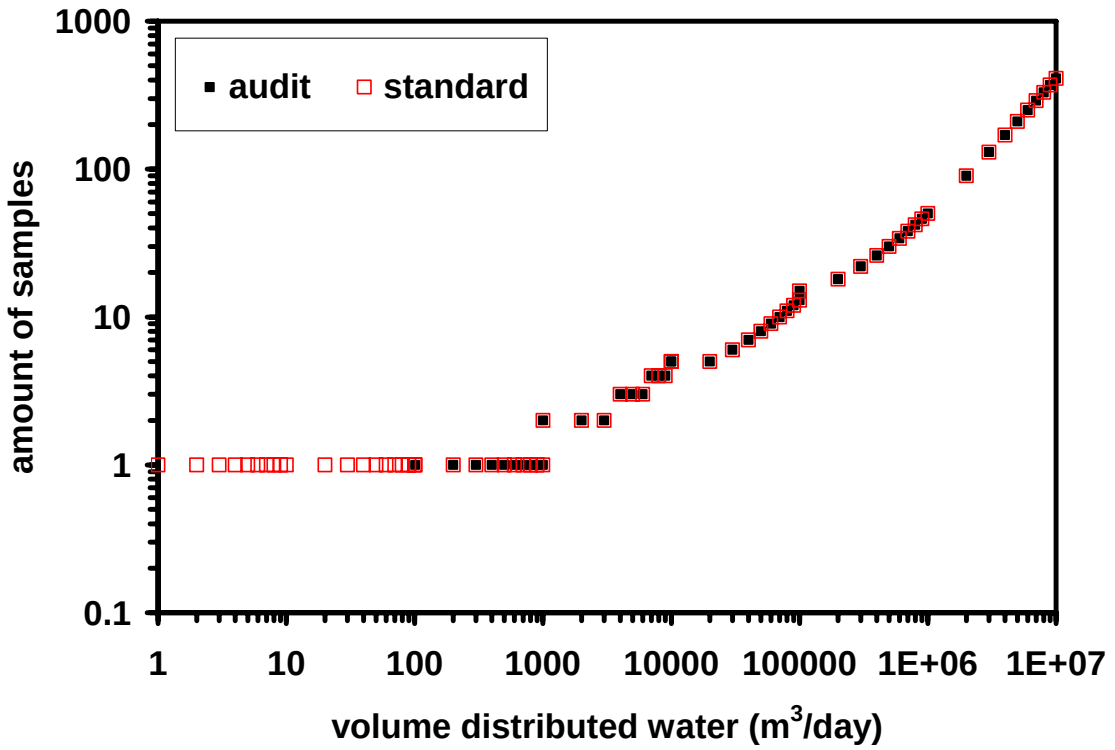

Figure 4 **The minimum sampling frequency of other parameters than mentioned in Figure 2 and Figure 3 remain the same**

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Abstract

The scope of the Ad-Hoc Working Group on Sampling and Monitoring is to give advice on selection of sampling points, sample protocols and sample frequencies in the framework of the revision of the Council Directive 98/83/EC on the quality of water intended

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the MSs, while being independent of special interests, whether private or national.


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