

## **Title: Metrology for emerging pollutants and new tools in aquatic environments**

### **Abstract**

Providing accurate and comparable measurements is a requirement of the European Commission to satisfy the goals of Directives such as the Water Framework Directive (WFD) (2000/60 EC). The list of priority substances that has been established in the context of the WFD is a dynamically evolving one, which imposes on the Member States significant monitoring obligations. New metrology, validated methods and tests are required in order that emerging pollutants like pharmaceutical residues, nanomaterials, and complex chemical matrices can be effectively monitored in aquatic environments, and the potential interaction and impact of chemical cocktails explored. In addition new tools are required to enable more effective monitoring of existing pollutants within the WFD and the Marine Strategy Framework Directive.

### **Conformity with the Work Programme**

This Call for JRP's conforms to the EMRP 2008, section on "Grand Challenges" related to *Environment* on pages 8, 9, 13, 24 and 25.

### **Keywords**

Emerging pollutants, European Water Framework Directive (WFD), reference method, reference materials, SI traceability, method validation, pharmaceutical residues, pesticides, heavy metals, priority substances, suspended particulate matter, nanomaterials, aqueous environment, bio-metrology, toxicity, chemical cocktails, monitoring, synergistic effects.

### **Background to the Metrological Challenges**

Clean water is vital for public health and ecosystems. In Europe, the implementation of the Water Framework Directive (2000/60/EC) aims to prevent any further deterioration of water bodies and the protection and enhancement of the status of aquatic ecosystems and associated wetlands. As part of this strategy, a list of 33 priority substances was adopted at Community level. In addition, the WFD requires Member States to identify specific pollutants in the River Basins and to include them in the monitoring programmes.

Emerging pollutants can be defined as those that are currently not included in routine monitoring programmes at the European level and which may be candidates for future regulation pollutants eg: endocrine disruptors, plastifiants, toxins, natural hormones, nanoparticles, pharmaceuticals. Emerging pollutants are not usually covered by standard methodologies, proficiency testing nor certified reference materials, and where existing standards exist they do not necessary fulfil the QA/QC Directive requirements.

Pharmaceutical residues from human and veterinary medicine enter water ecosystems in wastewater effluents and/or in the case of animal waste via surface run-off, residues may also be present in aquatic systems due to discharges from industry and other sources. Their presence in the environment is of concern due to their pharmacological activity. They appear in low levels ( $\text{ng L}^{-1}$  to  $\text{ng L}^{-1}$ ) and their determination requires robust analytical procedures involving the workup of a large number samples that can have complex matrices (e.g. waste waters). The analytical methodologies for determining the levels of pharmaceutical residues are still evolving and are applied at the level of

individual laboratories, however, there is a need for harmonisation and validation of analytical methods

Currently assessment of the environmental effects of chemicals only considers for one chemical at a time. Although, it is well known that there could be synergistic effects on both health and environment, until now comparatively little has been done to overcome this obstacle. The European Environment and Health Strategy (SCALE) and the EU Action Plan on Environment and Health (2004-2010) (COM(2004) 416 final) recognise the need to take into account synergistic effects of chemical cocktails in risk assessments. Chemicals have very varied effect and modes of action, e.g. some chemicals might not be directly toxic but could make an organism more sensitive to other chemicals or more easily take up other (toxic) chemicals. Therefore a chemical that by itself is not determined to be toxic when tested alone might synergistically act with other chemicals to increase the detrimental effects of the latter.

In addition new tools are required to enable more effective monitoring of existing pollutants. An extensive range of alternative methods for laboratory or field applications is becoming available and has to be evaluated with a metrological endpoint. In the area of field applications, numerous European (as well as international) environmental agencies have clearly expressed their strong interests and attempts for future monitoring methods.

In the context of the Common Implementation Strategy Process of the WFD (CIS) Member States have expressed the need to better integrate chemical monitoring with the ecological status assessment of Europe's water and groundwater bodies and although suitable effect-based tools do exist, no uniform introduction, for instance as screening of these tools, has been done so far. Unlike the successful introduction of CALUX DR and other screening tests for dioxin measurement in food, no consensus on the use of effect-based tool kits has been achieved among the MS so far. Introducing a sound and traceable measurement system for effect-based monitoring would cause a considerable boost in the dissemination of this technique and would allow Member States to fulfil their monitoring obligations with fewer resources, thus leaving sufficient room to address new priority substances.

## **Scientific and Technological Objectives**

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them, in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the JRP protocol.

The aim of the JRP should be to provide a metrological infrastructure to ensure comparability and accuracy of emerging measurements, methods and approaches applied to the monitoring of relevant pollutants in aquatic systems, to promote dissemination of traceability to the overall European Member States and to improve general knowledge's about occurrence, fate and effects of emerging pollutants in aquatic systems and consequently to participate to a better protection of environmental and human health.

The specific objectives are:

- 1) To develop and validate reference analytical laboratory methods with full uncertainty budgets for the measurements of relevant emerging pollutants (pharmaceuticals, toxins, nanomaterials etc,..)
- 2) To develop and validate on-going laboratory emerging analytical methods and approaches (extraction techniques, etc...) for the monitoring of key pollutants in relevant sub-compartments of aquatic system".
- 3) To develop and validate alternative emerging methods and approaches (sensors, passive samplers, toxicology kits, etc...) with full uncertainty budgets for the monitoring of relevant pollutants in aquatic systems. The emerging methods should have the potential for better information and/or lower costs compared with conventional methods.
- 4) To evaluate the feasibility to build the metrological basis for the dissemination of traceability by developing reference materials addressing relevant emerging substances in relevant environmental matrices.

Proposers need to carefully prioritise methods and species to be addressed, given the frame conditions of a typical joint research project such as budget and project life-time. The proposers shall describe which stakeholder input their prioritisation is based on. Proposers shall give priority to work that meets documented stakeholder needs and may include measures to facilitate the development of European standards and Directives.

Proposers should establish the current state of the art, and explain how their proposed project goes beyond this.

## Potential Impact

Proposals must demonstrate adequate and appropriate participation/links with the “end user” community. This may be through the inclusion of unfunded JRP partners or collaborators, or by including links to industrial/policy advisory committees, standards committees or other bodies. Evidence of support from the “end user” community (eg letters of support) is encouraged.

Where a European Directive is referenced in the proposal, the relevant paragraphs of the Directive identifying the need for the project should be quoted and referenced. It is not sufficient to quote the entire Directive per se as the rationale for the metrology need. Proposals must also clearly link the identified need in the Directive with the expected outputs from the project.

In your JRP submission please detail the impact that your proposed JRP will have on the following Directives: Water Framework Directive (2000/60/EC) in conjunction with the QA/QC Directive (2009/90/EC).

You should also detail other impact of your proposed JRP as detailed in the document “Guidance for writing a JRP”

You should detail how your JRP results are going to:

- feed into the development of urgent standards through appropriate standards bodies
- transfer knowledge to calibration and test laboratories, environmental monitoring sector, regulators and policy makers.

You should also detail how your approach to realising the objectives will further the aim of the EMRP to develop a coherent approach at the European level in the field of metrology. Specifically the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of Member States and countries associated with the Seventh Framework Programme whose metrology programmes are at an early stage of development to be increased
- outside researchers & research organisations other than NMIs and DIs to be involved in the work

## Time-scale

The project should be of 3 years duration.

## Additional information

- [1] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0060:EN:NOT>
- [2] QA/QC Directive (2009/90/EC), “COMMISSION DIRECTIVE 2009/90/EC of 31 July 2009 laying down, pursuant to Directive 2000/60/EC of the European Parliament and of the Council, technical specifications for chemical analysis and monitoring of water status”, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:201:0036:0038:EN:PDF>
- [3] DIRECTIVE 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC

and amending Directive 2000/60/EC of the European Parliament and of the Council, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:348:0084:0097:EN:PDF>

[4] DIRECTIVE 2008/56/EC Marine strategy Framework Directive