Title: Absorbed dose in water and air

Abstract

Radiation dosimetry underpins much of the radiotherapy treatment or diagnostics of patients and the radiological protection of the environment. For example on average in Europe there is one radio diagnostic examination per person and per year. The availability of reliable and traceable measurement facilities for the dissemination of the dosimetric units to the network of secondary standard dosimetry laboratories (SSDLs) is therefore an important factor. Graphite cavity chambers can be used for the measurement of air kerma rates of gamma ray sources for photon energies such as those of ^{60}Co and ^{137}Cs, free air chambers can be used for the measurement air kerma for low or medium X-ray energies and water calorimeters for the measurement of absorbed dose to water.

This topic is focused on enhancing the availability of radiological dosimetry facilities and research capability at NMIs/DIs within countries or regions in Europe where access to these types of facilities is currently limited.

Keywords

Radiation dosimetry, graphite cavity chambers, free air chambers, calorimeters, air kerma, absorbed dose to water, capacity building

Background to the Metrological Challenges

The international framework of traceability for radiation dosimetry quantities [1] ensures confidence in the equivalence of patient treatment regimes as required in international clinical trials for radiotherapy but also for fields as diverse as industrial processing, diagnostic medicine and radiation protection. The framework relies on some twenty countries with primary standard dosimetry laboratories (PSDLs) which validate their standards against each other through comparisons organised by the BIPM and then disseminate the SI for air kerma and for absorbed dose to water in terms of the gray (Gy), the special name designated for J/kg. The primary standards are usually free-air ionisation chambers for low and medium energy x-ray beams, cavity ionisation chambers for gamma beams and either graphite or water calorimeters for high-energy photon beams. A network of secondary standard dosimetry laboratories (SSDLs), established by the International Atomic Energy Agency (IAEA) and the World Health Organisation (WHO), ensure that standards traceable to the PSDLs (and hence the SI) are disseminated as widely as possible.

An NMI or DI wishing to establish a research capacity in this area would do so through the design, construction and validation of their own ionisation chambers and calorimeters. The design would build on the experience of more developed NMIs, using their expertise to optimise the design for the particular needs of that country. The validation process would involve the establishing NMI participating in comparisons and analysis of uncertainties with others establishing similar facilities and those with long established facilities. The whole process would result in both the development of a facility, the development of the relevant staff and the development of relationships between the establishing NMI and more experienced researchers in the field which would foster further joint research activities beyond the life of the project.

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 proposal.

The JRP shall focus on the development of metrological research capacity in radiation dosimetry.

The specific objectives are

1. To design, construct and validate graphite cavity chambers for those participating NMIs and DIs seeking to establish a research capability in measuring the air kerma for photon energies such as those of ^{60}Co and ^{137}Cs.
2. To design, construct and validate free air chambers for those participating NMIs and DIs seeking to establish a research capability in measuring the air kerma for low or medium X-ray energies.
3. To design, construct and validate calorimeters for those participating NMIs and DIs seeking to establish a research capability in measuring absorbed dose to water for high energy photon beams such as those produced by clinical accelerators.
4. For each participant to develop an individual strategy for the long-term development of their research capability in radiation dosimetry including priorities for collaborations with the research community in their country, the establishment of appropriate quality schemes and accreditation (e.g. participation in key comparisons, the entry of CMCs into the BIPM database, accreditation to ISO/IEC 17025). They should also develop a strategy for offering calibration services from the established facilities to their own country and neighbouring countries. The individual strategies should be discussed within the consortium and with other EURAMET NMIs/DIs, to ensure that a coordinated and optimised approach to the development of traceability in this field is developed for Europe as a whole.

Proposers shall give priority to work that meets documented metrological needs and activities that will lead to an improvement in European metrological capability and infrastructure beyond the lifetime of the project.

Proposers should establish the relevant current capability for research, and explain how their proposed project will develop capability beyond this.

EURAMET has defined an upper limit of 500 k€ for the EU Contribution to any project in this TP, and a minimum of 100 k€.

EURAMET also expects the EU Contribution to the external funded partners to not exceed 10 % of the total EU Contribution to the project. Any deviation from this must be justified.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the “end user” community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the “end user” community (e.g. letters of support) is also encouraged.

You should detail how your JRP results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Provide a lasting improvement in the European metrological capability and infrastructure beyond the lifetime of the project,
- Facilitate improved industrial capability or improved quality of life for European citizens in terms of personal health or protection of the environment,
- Transfer knowledge to the clinical and radiation protection sector and the metrology community.

You should detail other impacts of your proposed JRP as specified in the document “Guide 4: Writing a Joint Research Project”.

You should also detail how your approach to realising the objectives will further the aim of EMPIR to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. 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 EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work

Time-scale

The project should be of up to 3 years duration.

Additional information

The references were provided by PRT submitters; proposers should therefore establish the relevance of any references.

[1] Metrologia 46 (2009) S1- S8