EMRP Call 2010 - Industry & Environment

Topic number: SRT-18e

Title: Metrology for radioactive waste management

Abstract

It is imperative that the thousands of tonnes of low and intermediate level radioactive wastes arising each year from the decommissioning of nuclear facilities and the clearance of sites are disposed of in a manner which is (i) safe, (ii) secure, (iii) socially-acceptable, and (iv) cost-effective. Key metrological problems must be addressed if the nuclear and ionising radiation industry is to achieve these goals. These include the needs for novel methods, standards, decay data, reference materials and instruments for radioactive waste measurements. Only accurate and traceable measurements will ensure waste is consigned to the correct waste stream.

Joint Research Projects (JRPs) submitted for this topic should aim at addressing these needs via a programme of research in the ionising radiation and environmental areas improving the instruments, measurement methods, references and decay data to be used.

Conformity with the Work Programme

This Call for JRPs conforms to the EMRP 2008, section on *"Grand Challenges"* related to *Environment* on pages 8-9 and 24-25

Keywords

Nuclear, waste management, ionising, radioactive, radiation, reference material, release, clearance.

Background to the Metrological Challenges

Many of nuclear facilities are in operation in the EU and a significant number are in the decommissioning phase of their life cycle, thus dealing with the 'legacy' of waste is now a pressing environmental issue. Accurate waste sentencing is a vital aspect of this process. However, the inventory of wastes, which are potentially radioactive, comprises very large quantities of a wide range of materials (typically, building materials, soil and laboratory wastes). Accurate sentencing is frequently hampered by poor historical site records and a lack of suitable measurement methods, facilities, calibration standards and reference materials appropriate for the materials to be measured.

For radioactive waste management at nuclear facilities and other workplaces with radioactive sources, measurement of activity and derived quantities is crucial. Accurate measurement of the activity of specific radionuclides enables decisions to be made about the waste disposal route (e.g. either "free release" to the environment or to a repository). This is vital both for public safety and for minimizing waste repository costs. Activity is always defined for certain radionuclides and activities of particular selected radionuclides must be measured. For this purpose spectrometric devices should be used having high throughput, high resolution, high sensitivity and a wide measurement range. These devices must enable compliance with legal clearance levels for free release or material characterization for repository and be as accurate as possible.

Many measurements (e.g. radiochemical analyses for alpha-emitters) are carried out by sampling and off-site analysis. This introduces sampling problems, time delays and significant additional costs. There is a need to improve the scope of in-situ measurements to minimize these problems. In-situ techniques are also needed to help segregate waste prior to sentencing. This can reduce the volumes of waste at the higher activity levels and reduce costs. All measurements of radioactive wastes from sites (whether non-destructive or carried out by radiochemical analysis off-site) require appropriate standards and reference materials if they are to be accurate and reliable. Few such materials are

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available and the need for them has been clearly demonstrated at NMI user meetings. In addition, for some of the most abundant long-lived fission and activation products present in nuclear fuel and ultimately in nuclear wastes, there is some evidence that the data used (such as half-life values) are inconsistent or insufficiently known.

At the repository stage, certain stored waste containers are vented and can emit bulk and trace gases (both radioactive and non-radioactive, e.g. radon, CH_4, CO_2 or H_2). The composition of the effluent may vary with time as the waste 'ages' under anaerobic conditions. The radioactive species in gaseous effluents are a potential source of public or worker exposure and monitoring techniques for both these and the non-radioactive bulk gases are required to minimize this hazard.

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 your JRP should be to provide validated and reliable measurements/reference methods with traceability wherever it is practicable to do so for radioactive waste management.

The specific objectives are:

1. Development of standardised traceable measurement methods for solid radioactive waste free release (clearance levels verification) and for acceptance of solid radioactive wastes to repositories (acceptance criteria verification), according to international recommendations (EC and IAEA): design of measurement facilities, software, calibration and testing methods.
2. Development of novel instruments and methods for in-situ measurements, e.g.: improved on-site radiochemical analysis, rapid in-situ screening techniques for alpha/beta and gamma emitters, measurement of activity at varying depth, …
3. Development of a gaseous effluent monitor/sampler for stored wastes. Rapid, sensitive methods are required to determine rates of bulk gas production, chemical composition (CH_4, CO_2 or H_2, …) and activity concentrations of key radionuclides (e.g. ^{3}H, ^{14}C, ^{222}Rn).
4. Development of standards and 'spiked' or characterized 'real' reference materials for ensuring accurate, traceable radio-assays of materials from sites (concrete, steel, aluminium, cables, wood, insulator and others).
5. Improvements to decay data for selected radionuclides present in nuclear wastes, including long-lived fission and activation products.

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 (e.g. letters) 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.

You should detail the impacts 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 the nuclear waste industry.

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

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

[1] Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste.

[2] Directive 1999/31/EC of the European Parliament and of the Council of 26 April 2006 on the landfill.

[3] Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control.

[4] Council Directive 91/689/EEC of 12 December 1991 on hazardous waste.

[5] Council Directive 96/29/EURATOM of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation.

[6] Commission Recommendation of 18 December 2003 on standardised information on radioactive airborne and liquid discharges into the environment from nuclear power reactors and reprocessing plants in normal operation (2004/2/Euratom)

[7] European Commission, COM(2005)666, A thematic strategy on the prevention and recycling of waste.

[8] European Commission, COM(1998)463, The competitiveness of the recycling industries.

[9] European Commission, COM(1994)66, A community strategy for radioactive waste management.

[10] European Commission, COM(2004)526, The safe management of the spent nuclear fuel and radioactive waste.

[11] IAEA Safety Standards Series No. NS-G-2.7, Radiation protection and radiation waste management in the operation of nuclear power plants Safety Guide, 2002.

[12] IAEA Safety Standards Series No. GSR Part 5, Predisposal management of radioactive waste, 2009.

[13] IAEA Safety Standards Series No. GS-G-3.3, The management system for the processing handling and storage of radioactive waste, 2008.

[14] IAEA Safety Standards Series No. WS-G-2.7, Management of waste from the use of radioactive material in medicine, industry, agriculture, research and education, 2005.

[15] IAEA Safety Standards Series No. WS-G-2.5, Predisposal management of low and intermediate level radioactive waste Safety Guide, 2009.

[16] IAEA TECDOC-1537, Strategy and Methodology for Radioactive Waste Characterization, 2007.