NPL Report to the CCRI(II) meeting 2007

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Introduction

The National Physical Laboratory (NPL) is the United Kingdom's national measurement institute. The laboratory underpins the technical and administrative infrastructure needed to ensure that measurements of physical quantities in the UK are accurate, consistent and linked to the international measurement system.

The projects in the field of radioactivity metrology are carried out under contract to the National Measurement System Policy Unit, a division of the Department of Business, Innovation and Skills. The projects are subject to peer-review by a committee of scientific experts representing all users of radioactivity, including medical physicists, radiochemists and health physicists.

The work therefore covers a wide range of different projects, from fundamental work on primary standards to organising workshops to encourage the adoption of best measurement practice. A brief summary is given below, after describing the facilities.

Facilities

The NPL facilities include:

- Radiochemistry suite
  - Fume cupboards and glove boxes for handling a wide range of activities
  - A separate facility for low activity solutions
  - Source preparation laboratory with high accuracy electronic balances
- Primary standardisation laboratories
  - 4π β-γ coincidence systems (equipped with atmospheric pressure and high pressure proportional counters or liquid scintillation counters), with analogue and digital pulse processing systems
  - Gas counting systems and gas handling rig
  - TDCR
- Secondary measurement laboratories
  - High resolution γ-spectrometers (including low background, high efficiency detectors)
  - α-spectrometers
  - Ionisation chambers
  - NaI(Tl) spectrometer
  - Multi-wire proportional counter for source emission measurements
  - Liquid scintillation counters (Beckman and Quantulus (PerkinElmer))

Quality Assurance

NPL operates a quality management system that has been independently audited and approved to ISO17025 and ISO9001. NPL are receiving initial accreditation to ISO Guide 43 Part 1 (Comparisons) in the autumn of 2009 and will thereafter apply for accreditation for Guide 34 (Reference Materials).

Staff

The Radioactivity group currently has 16.4 fulltime staff in total and 1.5 temporary staff, including physicists, radiochemists and technicians. In addition, the group is supporting a Ph.D. student at the University of Surrey and a three months studentship from Grenoble National Polytechnic Institute. The group also draws on expertise from other sections at NPL, such as from the Radiation Dosimetry and Neutron Group and the Mathematics Group.

Work performed in the last two years

- Participation in Key Comparisons
  - The group participated in ^{85}Kr, ^{3}H and ^{177}Lu CCRI(II) key comparison exercises.
- Other standardisations
  - Samples of ^{56}Mn, ^{134}Cs and ^{166m}Ho were submitted to the BIPM SIR system.
  - Further standardisations of the short-lived PET radionuclide ^{64}Cu are on-going in a collaboration with a local hospital.
  - A bilateral comparison of ^{210}Pb standards involving standardisation of ^{210}Pb solution using three methods: Cerenkov counting, LS counting and alpha spectrometry.
  - ^{209}Po and ^{99}Tc standardised for environmental monitoring.
- Support for the international measurement system
  - A ^{99}Tc^{m} solution was submitted to the SIR in support of validation of the Transfer Instrument (TI) developed at BIPM. The TI was developed for the purpose of linking short-lived radionuclides to the SIR. Trials with the TI were performed at NPL.
  - Collection of detailed and accurate coincidence counting data of sources of ^{60}Co in order to support the Uncertainty Working Group at BIPM to estimate uncertainties related to extrapolation function using this technique.
- Other activities
  - Two ICRM working group meetings held at NPL in November 2008 – Liquid scintillation WG and Life Sciences WG.
  - EURAMET Road maps for preparation for an EMRP call on Energy in June 2009 – meeting held at NPL in November 2008 with Technical Committee members from Ionising Radiation.
  - Evaluation of nuclear decay data for inclusion in DDEP and IAEA databases – evaluation of ^{232}U and ^{232}Th complete.

- Development of a primary standard for positron-emitting radionuclides in gas (collaboration with the University of Surrey). Ph.D. thesis to be defended in Autumn 2009.
- Provision of reference solutions, workshops, laboratory proficiency testing exercises and measurement Good Practice Guides. User fora dedicated to Liquid scintillation, Radionuclide Calibrators and Nuclear Detection has been run annually. GPG 34 – *Radiometric Non-destructive Assay* is up for revision to include a wider range of applications. A new GPG on *Mathematical Modelling of Waste Detector Efficiencies* has been written. Final draft due in May 2010.
- Environmental proficiency test 2008 had 80 participants worldwide, in total 250 samples distributed. A new feature is solid samples. Results from 2007 exercise presented in workshop January 2008.
- Nuclide specific calibration figures for the new radionuclide calibrator "Fidelis" (ionisation chamber) marketed by Southern Scientific Ltd.
- The TDCR system has been upgraded with a light tight housing. Paper on TDCR prepared for ICRM2009 in Bratislava.
- Development of new gas rig for primary gas proportional counting and validation studies completed. Paper will be presented at ICRM 2009.
- First waste-drum comparison exercise completed with post-exercise workshop in September 2007. Seventeen organisations participated and a new comparison is in progress. There are two activity levels available and the radionuclides are distributed in a heterogeneous way this time. The work is being done to increase confidence in waste measurements in nuclear site decommissioning.
- An upgraded high-pressure proportional counter with pressure control system has been partly has been developed and is now being manufactured.
- Half-life measurements on-going of ^{109}Cd, ^{177}Lu and ^{64}Cu.

Future work

- Preparation of sources for the upcoming ^{241}Pu CCRI(II) key comparison.
- Standardisation and determination of nuclear data of ^{64}Cu for EURAMET project.
- Standardisation of other radionuclides for CCRI(II) key comparisons (e.g. ^{241}Pu) and radionuclides needed by the user communities.
- Validation of transfer instrument using the primary standard for positron-emitting radionuclides in gas (to support the measurement of stack discharges by Cyclotron Units for positron emission tomography).
- Continued provision of reference solutions, workshops, laboratory proficiency testing exercises and measurement Good Practice Guides.
- The second waste-drum reference material to be circulated (end date November 2009) to nuclear site operators and contractors to test the accuracy of the measurements. Workshop to be held February 2010.
- Evaluation of the decay data of ^{228}Ac and ^{231}Pa is under way for the International Atomic Energy Authority's Coordinated Research Program F42006: Updated Decay Data for Actinides, with a planned submission date of end of 2009 for inclusion in the DDEP.