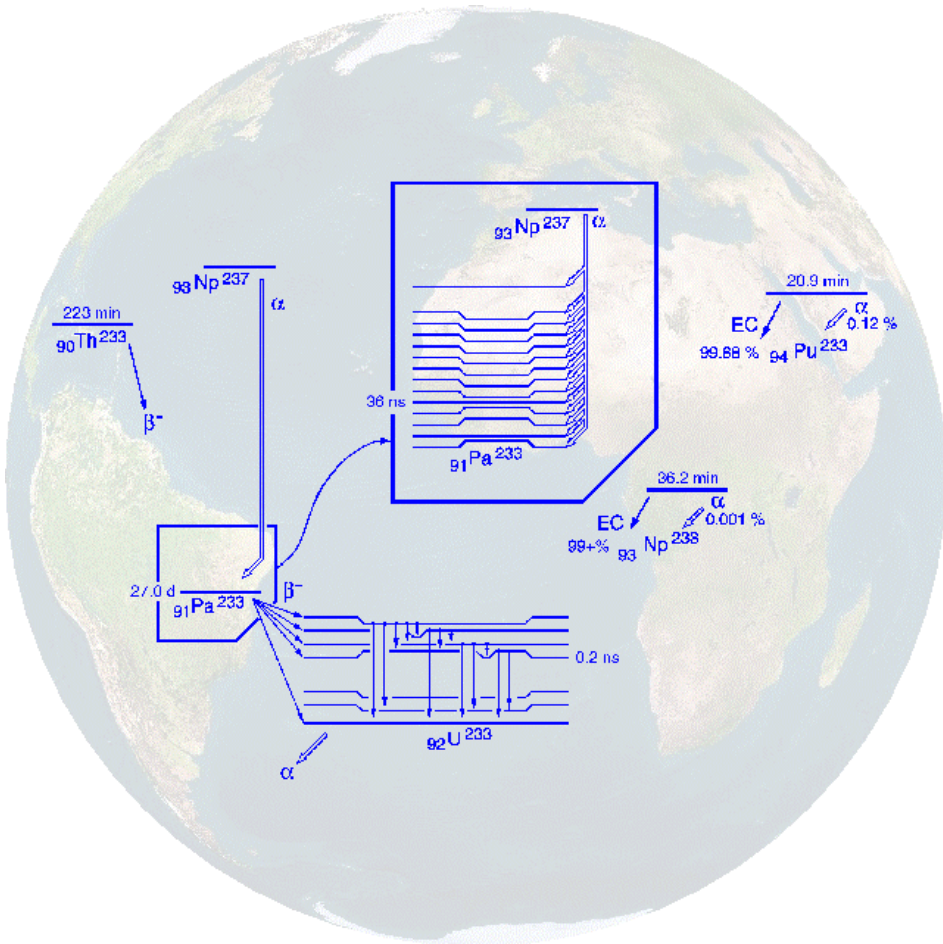
# ICRM NEWSLETTER

**Issue 17 - April 2003**




International Committee for Radionuclide Metrology

Editor : Nelcy Coursol

LABORATOIRE NATIONAL
HENRI BECQUEREL

# International Committee for Radionuclide Metrology ICRM

# ICRM NEWSLETTER
## Issue 17



Editor : Nelcy Coursol
BNM-Laboratoire National Henri Becquerel (BNM-LNHB)
CEA-Saclay
91191 Gif-sur-Yvette Cedex
France
Tel. : + 33 (0)1 69 08 27 78 or 85 67
Fax. : + 33 (0) 1 69 08 26 19
E-mail : nelcy.coursol@cea.fr

March 2003

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# EDITORIAL

This newsletter was established in response to a recommendation of the International Committee for Radionuclide Metrology made during its General Meeting in Grenoble 1985. It is meant to serve as a medium for informal exchange of information between workers active in the field of Radionuclide Metrology.

The scope of the Radionuclide Metrology Newsletter is to describe briefly current activities in the following topics :

- foil and source preparation;
- $\alpha$-, $\beta$- and $\gamma$-ray spectrometry including spectrum evaluation;
- improvement and development of radionuclide measurement techniques;
- measurement and evaluation of radionuclide data;
- low-level radioactivity measurement techniques;
- life-sciences;
- quality assurance and traceability.

In order to ensure that the Newsletter is as comprehensive and informative as possible, contributions are sought from all laboratories known to be engaged in measurements and data evaluation techniques relevant to Radionuclide Metrology.

All previous contributors will be informed concerning the deadline for the next issue. New contributing Radionuclide Metrology laboratories are welcome. Please contact the editor.

Any comments on this issue or suggestions for improvement will be welcome.

At the ICRM General Meeting in Paris 1995, it was decided that the ICRM Newsletter would also allow for the distribution of Progress/Planning Reports SA1 and SA2.

From the experience of this issue, we have the following situation : Laboratories regard their normal Newsletter contribution as the fulfilment of SA1/SA2. In this case this is indicated on the contribution by “SA1/SA2”. Or laboratories provide (additionally) the traditional SA1/SA2 reports which should not be longer than 2 pages. In the latter case it should be mentioned in the accompanying letter, that the SA1/SA2 contributions be intended for publication in the Newsletter.

# IMPORTANT NOTE

- For economy reasons subscriptions to the **ICRM** Newsletter have to be renewed **yearly.**
- Please use the mailing list form (last page of this issue) and copy it for your colleagues or any other person interested.
- All laboratories engaged in radionuclide metrology are invited to contribute to the next issue**.**
- In case you did not contribute to this issue, please inform the editor in order to be invited for the next issue in due time.
- Contributions may be sent by E-mail as an attachment in MS Word or as plain text file. This has been tested and will work well in most cases.

# INSTRUCTIONS TO CONTRIBUTORS

This Newsletter is printed by direct photographic reproduction with no alterations by the editor. To ensure readability and avoid unnecessary work by the editor, it is suggested that :

- Contributions should be typed on plain white A4 paper (21cm x 29,7cm) **format** inside a box of **15,5cm x 20cm** which should be situated **4,5cm** from the upper and **3cm** from the left margin. Please use font **Times New Roman** size **12**. The format indicated below should be followed.
- Contributions should contain **no** page number, date, signature, or any correspondence references typed on this sheet. Correspondence to the editor must be on a separate sheet.
- Contributions should be in English and carefully proofread by the authors.
- References to publications or reprints should be completed as required by the Physical Review.
- Complete mailing address and the name of a person who can be contacted for additional information by those desiring it should be given at the end.
- Please use the **"contribution.dot**" file included on the pdf version of this issue.

| | |
|---|---|
| LABORATORY | Name of laboratory |
| NAMES | If more than one laboratory is involved, identify affiliation through abbreviations (ORNL, LASL, etc.).<br>Visitors can also be identified with asterisks. |
| APPARATUS<br>ACTIVITY | Choose one; the former for experiments and the latter for compilations, calculations, or theory. |
| RESULTS | Use this for experimental results. |
| PUBLICATIONS | Use Physical Review style. Include only published materials. |
| IN PROGRESS | Use this for description of the current work. |
| INFORMATION<br>SOURCE | Use this for evaluations or compilations. |
| IN PREPARATION | Use this to also indicate papers submitted for publication. |
| OTHER RELATED<br>PUBLICATIONS | Optional. |
| ADDRESS | Mailing address. Give also telephone, telex, fax numbers and E-mail. |
| CONTACT | Single contact person. |

## President's Message

The International Committee for Radionuclide Metrology (ICRM) is an association of radionuclide metrology laboratories whose membership is composed of delegates of these laboratories together with other scientists (associate members) actively engaged in the study and applications of radioactivity. It explicitly aims at being an international forum for the dissemination of information on techniques, applications and data in the field of radionuclide metrology. This discipline provides a range of tools for tackling a wide variety of problems in numerous other fields, for both basic research and industrial applications.

There are 29 institutions now represented by delegates in the ICRM. The ICRM has no membership fee and no paid secretariat or other staff. Its overall direction is determined by the delegates in General Meetings, which convene usually every two years, where organizational guidelines and directions for the working programs are agreed upon. The following officers of ICRM are presently serving on the Executive Board

| | |
|---|---|
| President | M.J. Woods[1] |
| Vice-President | H. Janszen[2] |
| | Y. Hino[3] |
| | B.R.Simpson[4] |
| Past-President | B.M. Coursey[5] |
| Secretary | P. de Felice[6] |

The Executive Board relies heavily on the Nominating Committee which has the objective of ensuring the continuity of purpose and vigour of ICRM. It does this by soliciting from the membership, and by itself proposing, the names of eligible candidates to fill vacancies about to occur on the Executive Board and the Nominating Committee. The current membership of this committee is:

| | |
|---|---|
| Chairman | N Coursol[7] |
| Members | M Sahagia[8] |
| | G Winkler[9] |

ICRM activities are largely the responsibility of its working groups. Each group is guided by a co-ordinator who acts as a centre for ideas and communications and may organize conferences and workshops. There are now seven working groups with the following fields of interest:

(1) Alpha-Particle Spectrometry
E. Garcia-Torano[10]

(2) Gamma-Ray and Beta-Particle Spectrometry
J.M. Los Arcos[10]

(3) Liquid Scintillation Techniques
P. Cassette[7]

(4) Low-Level Measurement Techniques
S.M. Jerome[1]

(5) Non-Neutron Nuclear Data
A.L. Nichols[11]

(6) Radionuclide Metrology Techniques
J. Keightley[1], M. Unterweger[5]

(7) Life Sciences
B. Zimmerman[5]

Plenary meetings of the ICRM are held biennially, and have developed into a successful instrument of communication among various specialists, thus encouraging international co-operation. The majority of effort from ICRM during 2002 has concentrated on the planning and organisation for the next plenary meeting (ICRM 2003) which will take place on 2 – 5 June 2003 at the University College Dublin, Ireland. The local organisation is being coordinated by Dr Peter Mitchell from the Department of Experimental Physics together with a team of university staff. A meeting of the ICRM Conference Scientific Committee met in Dublin in December 2002 in order to select suitable abstracts from those submitted and to establish an agenda for the scientific sessions at the plenary meeting. Session chairmen and referees were also selected for the various subject groups. Almost 150 abstracts were received, the highest number yet. The time available for the meeting and restrictions on the number of journal pages for published papers dictated that only about 90 papers could be accepted for oral and poster presentations. Some abstracts were rejected either because they were not suitable subject matter for this ICRM meeting or were not sufficiently new or topical. In addition, a number of abstracts were redirected to the ICRM Low Level Techniques Working Group scientific meeting planned for October 2003. Agreement has also been for the publication of the proceedings in Applied Radiation and Isotopes. Details are available from http://www.ucd.ie/~icrm2003.

As noted above, the next scientific meeting of the ICRM Low Level Radioactivity Measurement Techniques Working Group is to be held in Vienna during 13 to 17 October 2003. The conference is organised under the auspices of ICRM, the Comprehensive Test Ban Treaty Organisation (CTBTO), the Austrian Research Centre Seibersdorf (ARCS), the Bundesamt fur Eich und Vermessungswesen (BEV) and the UK National Physical Laboratory (NPL). Full details of the programme, abstract submissions and reregistration can be obtained fro the website at http://www.icrm-llrmt.at.

Further information on these meetings together with details of the other activities of ICRM and its Working Groups is available from the ICRM web site at http:/ /physics.nist.gov/icrm

Anyone wishing to participate in ICRM's activities or to receive further information is encouraged to contact one of the officers or Working Group chairs.

March 2003 Mike Woods
President

**References**


1. Centre for Ionizing Radiation Metrology, National Physical Laboratory (NPL), Queens Road, Teddington, Middlesex TWll 0LW, U.K.
2. Physikalisch-Technische Bundesanstalt (PTB), Section 6.11, Bundesalle 100, D-38116 Braunschweig, Germany
3. Radioactivity and Neutron Section, Quantum Radiation Division,National Institute of Advanced Industrial Science and Technology (AIST)
   1-1-1 Umezono, Tsukuba, Ibaraki, 305-8568 JAPAN
4. Radioactivity Standards Laboratory, National Metrology Laboratory, CSIR-NML, ZA-Rosebank 7700, Cape Town, South Africa

5. National Institute of Standards and Technology (NIST), Ionizing Radiation Division, Physics Laboratory, Gaithersburg, Maryland, 20899-8460, U.S.A.

6. ENEA C.R. Casaccia, P.O. Box 2400, I-00100 Rome, Italy

7. CEA, DIMRI, Laboratoire National Henri Becquerel (LNHB-BNM), B.P. 52, F-91193 Gif-sur-Yvette Cedex, France.

8. National Institute of C&D for Physics and Nuclear Engineering (IFIN), P.O. Box MG-6, RO-76900 Bucharest, Romania

9. Institut fur Isotopenforschung und Kernphysik der Universitat Wien Radiuminstitut (IRK), Boltzmanngasse 3, A- 1090 Wien, Austria.

10. Centro de Investigaciones Energeticas, Medioambientales y Technologicas (CIEMAT), Fisica de Radiaciones Ioniz., Avenida Complutense 22, E-28040 Madrid, Spain.

11. Nuclear Data Section, Division of Physical and Chemical Sciences, Department of Nuclear Sciences and Applications, International Atomic Energy Agency (IAEA) Wagramerstrasse 5,
A-1400 Vienna, Austria

## Report of the Alpha-Particle Spectrometry Working Group

June 2001-December 2002

The aim of this Working Group (WG) was described in the document "*WG Scope and Actions*", issued in 1993. Since then no new areas of interest have been identified. Activities related to the objectives of this WG are described below.

Work has continued in the EUROMET project 591 on the measurement of nuclear data of $^{235}U$. Five laboratories are involved (BNM-LNHB, Univ. of Extremadura, IRMM, NPL and CIEMAT). The last coordination meeting was held at PTB in June 2001, in the ICRM-2001 conference. Since then, the main effort was put on the preparation of sources with improved spectral quality. IRMM has recently finished the preparation of a set of sources with a very pure material and an energy resolution of about 13 keV FWHM. Sources are being sent to the laboratories and measurements will be started very soon.

In the frame of the International Atomic Energy Agency Coordinated Research Program "Development and Applications of Alpha-Particle Spectrometry", the first version of a new Windows-based fitting program has already been distributed to participants for evaluation.

### Future actions

For the period 2002-2003, the main work will still be concentrated in the finishing of EUR591 and IAEA CRP actions. Additional actions must be discussed at the ICRM'2003 conference. WG members are encouraged to provide information about their activities to the WG coordinator.

E. Garcia-Torano, CIEMAT

tel :34 91 346 6225 fax :34 91 346 6442 E.Garciatorano@CIEMAT.ES

## Report of the Liquid Scintillation Counting Working Group

The Liquid Scintillation Counting Working Group was created in 1997 and its first meeting was held during the ICRM'99 conference in Prague. Further meetings were organized in Saclay in November 2000 and during ICRM symposium in Braunchweig in 2001. The aim of this working group is to share information on the use of liquid scintillation counting techniques in the field of radionuclide metrology. This working group focuses on the CIEMAT/NIST and the TDCR methods.

The following topics were discussed during the previous meetings:

- Ionisation quenching models and calculation of electron stopping power.
- Atomic an nuclear data needed (beta spectra shape factors, detailed X-ray and Auger K,L and M lines, etc.).
- Implementation of the CIEMAT/NIST method: CN2000B package and source preparation.
- Implementation of the TDCR method, detection efficiency calculation programs.
- Source stability studies (examples of $^{188}W/^{188}Re$ and $^{177}Lu$ ).
- Standardization of various nuclides (example of $^{18}F$, $^{11}C$, $^{153}Sm$, $^{226}Ra$, $^{222}Rn$ and $^{177}Lu$).
- Need to standardize very long-lived radionuclides for geochronology applications ($^{235}U$, $^{238}U$, $^{40}K$, $^{87}Rb$, $^{147}Sm$, $^{176}Lu$, $^{187}Rh$ and $^{190}Pt$).

The LSC working group web page is hosted by the BNM server and an is accessible, via an hyperlink, from the main ICRM web page or through the BNM web site at the following address:
http://www.bnm.fr/bnm-lnhb/icrm.htm

. Participant contributions are welcome and must be sent to the co-ordinator.

Philippe Cassette, BNM-LNHB
Philippe.cassette@cea.fr
Tel : 33 1 69 08 48 68
Fax : 33 1 69 08 26 19

## Report of the Low-Level Techniques Working Group

The main activity of the Low-Level Techniques Working Group has been to organise their next conference, to be held in Vienna as the guests of BEV, Vienna and ARCS, Seibersdorf.

The first announcement for the conference was circulated in autumn 2002 and to date ~90 expressions of interest have been received of whom ~75 have expressed an interest in presenting a paper at the conference.

The second announcement and call for abstracts is about to be issued, and it is planned to hold a meeting of the scientific committee to finalise the accepted papers and the scientific programme during the main ICRM conference in Dublin. It is hoped that there will be one invited speaker on each of the five days of the conference. A manufacturer's exhibition will also be held during the conference.

Arrangements will also be made to publish the conference papers in a refereed journal, which will probably be Applied Radiation and Isotopes. As with all ICRM organised conference, the paper will only be submitted for publication if the author(s) have presented it, in person, at the conference and after peer review by the scientific committee.

Simon Jerome
National Physical Laboratory
United Kingdom

tel. : + 44 20 8943 6204
fax : + 44 20 8943 6458
simon.Jerome@npl.co.uk

27 February 2003

# 2002 Annual Report: Non-Neutron Nuclear Data Working Group (3NDWG)

1. The primary aim on the 3NDWG is to provide the scientific community with a suitable environment in which specialists in the field of non-neutron nuclear data measurements and evaluations can learn more about each others' work, liaise and combine forces to undertake research programmes of mutual interest, and organise multinational efforts to produce sets of recommended non-neutron nuclear data.

2. Much of the communication between the most active members of the 3NDWG is related to the Decay Data Evaluation Project (DDEP) and the IAEA Co-ordinated Research Project (CRP) to Update X-ray and Gamma-ray Decay Data Standards for Detector Calibration and Other Applications. The final meeting of the IAEA-CRP was held in Vienna, 21-24 October 2002: content of the IAEA-TECDOC was discussed in detail, and deadlines for the remaining data evaluations and reviews were agreed. Hopefully, the recommended database will become available sometime in 2003.

3. DDEP co-ordinator:
Dr Edgardo Browne,
Isotopes Project, MS 50A-1148,
Lawrence Berkeley National Laboratory,
University of California, 1 Cyclotron Road,
Berkeley, CA 94720, USA.

This work continues with contributions from:
Brazil: Universidade de Sao Paulo;
France: DIMRI/LNHB;
Germany: PTB;
Russia: Khlopin Institute;
Spain: CIEMAT and UNED;
UK: NPL;
USA: INEEL and LBNL;
and IAEA Vienna.

Anybody interested in participating in this work should contact Edgardo Browne.

4. The next meeting of the 3NDWG will be held during the biennial meeting of the ICRM (2-6 June 2003, Dublin).

A L Nichols, 3NDWG Co-ordinator,
Internationsl Atomic Energy Agency,
Nuclear Data Section,
Department of Nuclear Sciences and Applications,
Wagramerstrasse 5, PO Box 100,
A-1400 Vienna, Austria.

Tel no.: (+43-1) 2600-1709/21710
Fax no.: (+43-1) 26007
e-mail: a.nichols@iaea.org

16 December 2002

## Report of the Life Sciences Working Group
## Coordinator's Report

The purpose of the Life Sciences Working Group (LSWG) is to identify and coordinate activities to solve issues related to the measurement of radionuclides in all aspects of the biological sciences, particularly, but not limited to, the field of nuclear medicine. Most of the Working Group's activities have, in fact, dealt with the metrology of radionuclides of interest in nuclear medicine, as well as the transfer of standards from the NMIs to the clinics. A brief description of these projects during the past year is given herein.

The final results of the $^{18}F$ intercomparison have been received by NPL. In all, 11 institutes (ANSTO, BNM-LNHB, CMI-IIR, INER, IPEN-CNEN, NIRH, NIST, NMi, NPL, NRC, and PTB) participated in the exercise. The results will be presented during the next Working Group meeting, to be held in conjunction with the ICRM conference in Dublin, and will also be published in an appropriate journal in the near future.

The IAEA hosted an international symposium on Standards and Codes of Practice in Medical Radiation Dosimetry in November 2002. One of the sessions dealt with quality assurance issues in internal dosimetry, during which presentations were made by delegates from CMI-IIR, NIST, and NPL regarding radioactivity measurement quality programs carried out by those instutions that are related to nuclear medicine. All three presentations highlighted the importance of accurate activity measurements in radionuclide therapy treatment planning and the continuing need for accurate radioactivity measurements in the clinic and radiopharmacy that are traceable to national or international standards.

An intercomparison of $^{90}Y$ was organized by NIST as a trial for a more complete exercise that will be conducted in late 2003. Solution sources were despatched to BNM-LNHB, NPL, and PTB. Measurement results are due in early February and will be presented at the Working Group meeting in Dublin, along with a draft proposal for a full Key Comparison.

It is hoped that discussions the above items, as well as other topics of general interest to the Working Group, will be conducted through the Working Group email list: icrmlswg@nist.gov. Those with interest that are not yet on the distribution list are encouraged to contact the Coordinator.

Brian E. Zimmerman
Life Sciences Working Group Coordinator

## News from Canada

| | |
|---|---|
| LABORATORY | National Research Council of Canada |
| NAMES | Dallas Santry, retired |
| APPARATUS ACTIVITY | The laboratory was shut down in November 2000 and is unlikely to reopen. |
| RESULTS | |
| PUBLICATIONS | |
| IN PROGRESS | I now have time to prepare for publication, some useful investigations related to calibrations over the past 20 years. |
| INFORMATION | |
| SOURCE IN PREPARATION | |
| OTHER RELATED PUBLICATIONS | The NRC 4 π-gamma Ionization Chamber.<br>NRC report PIRS-0755, February 2001. |
| ADDRESS | 2114 Stonehenge Cr. Gloucester, Ontario K1B 4N8 Canada , e-mail dallas.santry@nrc.ca |
| CONTACT | Dallas Santry |

**International Committee for**
**Radionuclide Metrology**

# ICRM

# CONTRIBUTIONS

| | | |
|---|---|---|
| LABORATORY | METROLOGIA DE RADIOISOTOPOS<br>CNEA, ARGENTINA | (SA1/SA2) |
| NAMES | P. ARENILLAS, L. APARICIO | |
| APPARATUS | 4πβ (PC)-γ (NaI) coincidence system.<br>4πβ (PPC)-γ (NaI) coincidence system.<br>4π proportional counter.<br>Si-PIP and surface barrier detectors. | |
| ACTIVITY | 1. Absolute activity measurements.<br>2. Participation in international comparisons. | |
| RESULTS | 1. Activity standardisation have been performed :<br>$^{65}$Zn, $^{60}$Co, $^{192}$Ir,$^{241}$Am<br>2. Participation in international comparisons :<br>$^{65}$Zn, $^{192}$Ir, $^{241}$Am with BIPM.<br>$^{60}$Co for SIR<br>3. Modification of a LSC TDCR System. | |
| IN PROGRESS | 1. Improvement of a new definite solid angle alpha system.<br>2. Improvement of a LSC TDCR system.<br>3. Improvement of a HPPC-NaI(Tl) coincidence system.<br>4. Absolute activity measurements.<br>5. Participation in the SIR for the activity measurements. | |
| ADDRESS: | Comisión Nacional de Energía Atómica, Centro Atómico Ezeiza.<br>Unidad de Actividad Radioquímica.<br>Av. del Libertador 8250.1429-Buenos Aires – ARGENTINA.<br>Telephone/Fax: (54-11) 4379-8408/8554.<br>e-mail: arenilla@cae.cnea.gov.ar | |
| CONTACT | P. A. ARENILLAS. | |

| | |
|---|---|
| LABORATORY | METROLOGIA DE RADIOISOTOPOS (SA1/SA2)<br>CNEA, ARGENTINA. |
| NAMES | G.L CERUTTI, X.L. ARAYA |
| APPARATUS | Liquid scintillation counting system. |
| ACTIVITY | 1.Measurement of natural and artificial radionuclides in environmental samples.<br>2. Participation in comparisons. |
| RESULTS | 1. Activity determinations of $^{90}$Sr in milk powder, oil, tea and yerba mate samples.<br>2. Activity determinations of gross alpha and gross beta in mineral water and lake water.<br>3. Activity determinations of $^{241}$Am and $^{239}$Pu in milk powder samples.<br>4. Participation in BIPM comparisons of $^{204}$Tl, $^{32}$P and $^{60}$Co by CIEMAT / NIST method.<br>5. Participation in BIPM comparison of $^{241}$Am by liquid scintillation counting. |
| IN PROGRESS | Implementation of a quality system based on Guide ISO 17025. |
| ADDRESS | Comisión Nacional de Energía Atómica, Centro Atómico Ezeiza.<br>Unidad de Actividad Radioquímica.<br>Av. del Libertador 8250.1429<br>Buenos Aires - ARGENTINA.<br><br>Telephone: (54-11) 4379-8408<br>Fax: (54-11) 4379-8554<br>e-mail: cerutti@cae.cnea.gov.ar |
| CONTACT | G. L. Cerutti |

| | |
|---|---|
| LABORATORY | METROLOGIA DE RADIOISOTOPOS (SA1/SA2)<br>CNEA, ARGENTINA. |
| NAMES | G.L. CERUTTI, F.A. IGLICKI, G.R. BOCCA, X.L. ARAYA |
| APPARATUS | High pressure ionisation chamber.<br>HPGe spectrometer systems.<br>HPGe planar detector.<br>NaI(Tl) scintillation detector.<br>Automatic sample changers.<br>Multichannel analyzers and personal computers. |
| ACTIVITY | 1. Preparation, quality control, standardisation and issue of :<br>Standard point sources and solutions of several radionuclides for gamma-ray and alpha spectrometry.<br>Large area standard sources of alpha, beta and gamma emitters.<br>2. Routine measurements and certifications of non radioactive contamination in imported or exported foodstuffs.<br>3. Development of standard sources. |
| RESULTS | 1. Preparation, quality control, standardisation and issue of 111 standard sources and solutions.<br>2. Certifications of non radioactive contamination in 2281 samples of imported and exported foodstuffs.<br>3. Determination of Co-60 activity in approximately 765 samples for surface contamination and sealed control of sources used in cobalt therapy. |
| IN PROGRESS | Implementation of a quality system based on Guide ISO 17025. |
| ADDRESS | Comisión Nacional de Energía Atómica, Centro Atómico Ezeiza.<br>Unidad de Actividad Radioquímica.<br>Av. del Libertador 8250.1429 - Buenos Aires - ARGENTINA.<br>Telephone: (54-11) 4379-8218<br>Fax: (54-11) 4379-8554<br>e-mail: iglicki@cae.cnea.gov.ar |
| CONTACT: | F. A. IGLICKI |

| | |
|---|---|
| LABORATORY | METROLOGIA DE RADIOISOTOPOS (SA1/SA2)<br>CNEA, ARGENTINA. |
| NAMES | M.I. MILA. |
| APPARATUS | Ionisation chamber dose calibrators.<br>High pressure ionisation chamber.<br>GeHp and NaI(Tl) gamma-ray spectrometer systems. |
| ACTIVITY | 1. Routine metrological assessment of radionuclide calibrators used in Nuclear Medicine.<br>2. Preparation, quality control and standardisation of standard sources for Nuclear Medicine.<br>3. Organisation of intercomparison for activity measurements among Nuclear Medicine Centres in Argentina. |
| RESULTS | 1. Assessment of 29 Nuclear Medicine Centre calibrators for $^{99m}$Tc, $^{131}$I and $^{201}$Tl.<br>2. Assessment of 24 commercial calibrators for $^{67}$Ga, $^{99m}$Tc, $^{125}$I, $^{131}$I and $^{201}$Tl. |
| IN PROGRESS | Organisation of intercomparison for activity measurements of $^{201}$Tl and $^{131}$I, among Argentinian Nuclear Medicine Centres. |
| ADDRESS | Comisión Nacional de Energía Atómica, Centro Atómico Ezeiza.<br>Unidad de Actividad Radioquímica.<br>Av. del Libertador 8250.1429-Buenos Aires - ARGENTINA.<br>Tel/Fax: (54-11) 4379-8554.<br>E-mail : mila@cae.cnea.gov.ar |
| CONTACT | M. I. MILA |

(SA1/SA2)

LABORATORY Australian Nuclear Science and Technology Organisation

NAMES Dimitri Alexiev, Li Mo, Mark Reinhard and Justin Davies

**Activities undertaken in 2002**

- Participated in the international inter-comparison of activity measurement of Tl-204 as organised by BIPM.

Developed a primary standard for measurement of Au-198 activity. The standard will be used for the verification of the neutron flux for ANSTO' RRR reactor.
Provided support to Australian Radiopharmaceuticals and Industries including ion chambers calibration, uncertainty analysis of Radiopharceuticals tertiary standards, I-123 intercomparison, photoemission rate measurement for Pu-238, and supply of standard sources.
Participated in a TLD postal dose audit of SSDL for IAEA/WHO Network in May 2002.
Maintained certification to the ISO 9001: 2000.

**Programme for 2003**

- To develop a liquid sintillation triple to double coincidence counting ratio (TDCR) system.

- To standardise Sm-153 using $4\pi\beta$(ppc)-$\gamma$ coincidence counting method.

- Participate in annual TLD postal dose audit of SSDL for IAEA/WHO Network in May 2003.

ADDRESS ANSTO
Australian Nuclear Science & Technology Organisation
New Illawarra Road
Lucas Heights NSW 2234

Tel: 61 2 9717 3182
Fax: 61 2 9717 9265
Website: www.ansto.gov.au

CONTACT Dr Dimitri Alexiev
E-mail: dax@ansto.gov.au

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|---|---|
| LABORATORY | Bundesamt für Eich- und Vermessungswesen (BEV)<br>Section: Ionizing radiation<br>Vienna, Austria |
| NAMES: | R. Edelmaier, P. Jachs |
| APPARATUR | HPGe detectors for gamma spectrometry<br>Calibrated 4π γ ionisation chamber<br>Low background anticompton HPGe spectrometer<br>Multiwire proportional counter<br>Radon chamber with traceable radon monitor |
| ACTIVITY: | Routine certification ( medical activity meter, surface contamination monitors, etc.)<br>Participation in international comparison (Euromet, CCRI) and bilateral comparison<br>Calibration service |
| IN PROGRESS | Preparation of the ICRM LLRMT conference in Vienna (www.icrm-llrmt.at)<br>Comparison of radon monitors (Euromet No. 657)<br>Ir-192 comparison (CCRI)<br>Am-241 comparison (CCRI)<br>Development of a large area proportional counter |
| ADDRESS | Bundesamt für Eich- und Vermessungswesen<br>Ionizing radiation section<br>Arltgasse 35<br>A 1160 Vienna |
| CONTACT | Robert Edelmaier<br>Tel: +43 1 49 110 - 372<br>Mobile: +43 676 8210 6372<br>Fax: +43 1 49 20 875<br>E-Mail: r.edelmaier@metrologie.at<br><br>Petra Jachs<br>Tel: +43 1 49 110 - 533<br>Fax: +43 1 49 20 875<br>E-Mail: p.jachs@metrologie.at |

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| LABORATORIES | IAEA Nuclear Data Section, Vienna, Austria;<br>Serco Assurance, Winfrith Science Centre, Dorchester, UK |
| NAMES | A L Nichols (IAEA); C J Dean and R J Perry (Serco Assurance) |
| ACTIVITY | Decay-data evaluations and preparation of databases |
| RESULTS/ INFORMATION | Decay-data evaluations underway in 2002-03:<br>(a) activation products: $^{81}$Se, $^{81m}$Se, $^{72}$Br, $^{72m}$Br, $^{94}$Sr, $^{99}$Zr, $^{110}$Rh, $^{110m}$Rh, $^{176}$W, $^{180}$Os, $^{196}$Os, $^{192}$Ir, $^{192m}$Ir, $^{192n}$Ir, $^{192}$Au, $^{192m}$Au, $^{192n}$Au (?) and $^{202}$Pt.<br>(b) heavy elements: $^{226}$Ra decay chain, and $^{228}$Th decay chain. |
| PUBLICATIONS | O Bersillon et al, "JEFF-3T: Decay Data and Fission Yield Libraries", ND2001 Int. Conf. Nucl. Data for Science and Technology, 7-12 Oct 2001, Tsukuba, Japan; also J. Nucl. Sci. Technol., Supplement 2, Vol 1 (2002) pp 478-480. |
| IN PROGRESS | Evaluation of decay data for DDEP under auspices of ICRM |
| INFORMATION | Re-evaluations planned in future years for DDEP: $^{97m}$Tc, $^{106}$Rh, $^{109}$Pd, $^{126}$Sb, $^{127}$Sb, $^{127}$Te, $^{127m}$Te, $^{132}$Te, $^{132}$I, $^{144}$Pr and $^{201}$Pb.<br>Possibility of additional evaluations for JEFF-3. |
| IN PREPARATION | Evaluations completed for DDEP: $^{56}$Mn, $^{203}$Hg, $^{228}$Th decay chain, and $^{234m}$Pa. Data files in preparation. |
| OTHER RELATED PUBLICATIONS | M Herman and A L Nichols, Update of X- and Gamma-ray Decay Data Standards for Detector Calibration and Other Applications: Summary Report of Second RCM, INDC(NDS)-415, September 2000.<br>M Herman and A L Nichols, Update of X- and Gamma-ray Decay Data Standards for Detector Calibration and Other Applications: Summary Report of Third RCM, INDC(NDS)-437, December 2002.<br>A L Nichols, Decay Data: Review of Measurements, Evaluations and Compilations, Appl. Radiat. Isot., 55 (2001) 23-70. |
| ADDRESS | IAEA Nuclear Data Section,<br>Department of Nuclear Sciences and Applications,<br>PO Box 100, Wagramerstrasse 5, A-1400 Vienna, Austria. |
| CONTACT | Dr Alan Nichols |

Summary of the research programme related to radionuclide metrology
for the years 2002 and 2003
at the "Institut für Isotopenforschung und Kernphysik" (IIK)
of the University of Vienna, Austria

Boltzmanngasse 3, A-1090 Wien; Tel: +43-1-4277-51754, FAX: +43-1-4277-51752
http://www.univie.ac.at/Kernphysik/irk_engl.htm

*[also to be regarded as contribution according to the ICRM standing actions SA1 and SA2]*

The activities at the IIK concentrate on the improvement and development of atomic and nuclear measuring techniques and data handling procedures for interdisciplinary applied physics work with special emphasis on the detection of long-lived radionuclides, particularly in the very-low-level range. Nuclear-decay-counting techniques have been widely replaced by mass-spectrometric techniques with high selectivity and high sensitivity. Updated and more detailed information about research at IIK during the last four years is also be provided via the institute's internet home page given above.

Names: R. Andrejic, M. Berger, R. Drosg, H. Friedmann, H. Figl, E. Friedl, R. Golser, P. Hille, J. Kühtreiber, W. Kutschera (director), J. Lukas, E. Pak, A. Pavlik, A. Priller, R. Schön, J. Schwarzenberg, P. Steier, B. Strohmaier, S. Tagesen, Ch. Vockenhuber, H. Vonach, E. Wild, G. Winkler, St. Winkler, P. Zimprich

1. The *tandem-accelerator mass-spectrometry facility VERA (Vienna Environmental Research Accelerator)* and its use

Accelerator mass spectrometry (AMS) is a major field of research at the IIK. With AMS the radionuclides are measured by direct atom counting; selectivity is achieved employing energy-, momentum- and velocity-selecting devices (electrostatic, magnetic and time-of-flight/Wien filters) and using ion detectors for counting and final energy measurement. The interesting nuclides (with extremely small radioisotope-to-stable-isotope ratios in the $10^{-10}$ to $10^{-15}$ range) cannot be measured at natural levels through radioactive-decay counting, particularly for small samples in the milligram range, typically containing only $10^5$ to $10^8$ radionuclide atoms. Predominantly isotope ratios are measured relative to appropriate standards. The VERA facility is based on a 3-MV Pelletron tandem accelerator (from National Electrostatics Corporation in Wisconsin, USA). For details on the experimental equipment see http://www.univie.ac.at/Kernphysik/VERA/welcome.htm .
Recently, the rejection of interfering ions was improved by installing a large electrostatic analyser for precision energy measurements at the high-energy side of the tandem, after the analysing magnet. Further, interfering ions which pass all beam filters are discriminated by a high-resolution time-of-flight system, using a 0.5 μg/cm$^2$ diamond-like carbon foil in the start detector substantially reducing beam straggling.

Through the recent upgrades of VERA it has been possible to measure ions from very heavy long-lived radionuclides such as $^{129}$I ($T_{1/2} \approx 1.6\times10^7$ a) [$^{129}$I/$^{127}$I ratios], $^{210}$Pb ($T_{1/2} \approx$ 22 a), $^{236}$U ($T_{1/2} \approx 23\times10^6$ a), $^{244}$Pu ($T_{1/2} \approx 81\times10^6$ a), $^{242}$Pu ($T_{1/2} \approx 3.8\times10^5$ a) and $^{182}$Hf [$T_{1/2} \approx (9\pm2)\times10^6$ a] in natural samples.

In co-operation with GSI Darmstadt, University of Mainz, and Kurchatov Institute Moscow, ion detection with a *calorimetric cryodetector* (sapphire crystal whose temperature rise is measured at the superconducting transition edge of an aluminium strip at about 1.5 K) was studied at the flight path for discrimination and energy spectroscopy of heavy ions showing improvement of the energy resolution up to two orders of magnitude better than with a surface-barrier detector.

2. AMS measurements combined with decay counting

a) Study of the *stratosphere-troposphere exchange (STE) via $^{10}$Be/ $^{7}$Be isotope ratios:* Stratosphere-troposphere exchange is one of the key factors controlling the budgets of ozone, water vapour and other substances in the troposphere and lower stratosphere. The two cosmogenic isotopes of Be, $^{10}$Be (measured by AMS) and $^{7}$Be (measured by decay counting), have very different half-lives; the combination of production rates, half-lives, and different residence times in the troposphere and stratosphere, results in $^{10}$B/ $^{7}$Be isotope ratios that can be used as fingerprints leading to improved estimates of STE. Air-filter samples collected at high-alpine stations are employed.

b) *Be- and Al-isotope ratios ($^{26}$Al)* in sediments for dating in geology

c) Effort to *reduce the large uncertainty* of the knowledge of the *half-life* of the neutron-rich isotope *$^{182}$Hf* [$T_{1/2} \approx (9\pm2)\times10^6$ a, measured 40 years ago].
The system $^{182}$Hf - $^{182}$W forms a geochronometer, which offers an excellent way to determine the time-scale for the early Solar System's accretion and the core formation of the planets. It can be used to study the early development of the Earth and the Moon through isotopic anomalies of its stable decay product $^{182}$W. $^{182}$Hf may also complement a few other radionuclides in the million-year half-life range to trace relatively recent stellar events with high neutron fluxes like nearby supernovas (inducing, e.g., $^{182}$Hf from the double neutron capture in $^{180}$Hf), e.g., by finding measurable traces of live $^{182}$Hf in suitable terrestrial archives.

3. Conventional radionuclide instrumentation and evaluation

*4π NaI(Tl) gamma well-type* detector (12.7 x 12.7 cm) with software to calculate total efficiencies and check the consistency of chosen decay schemes; shielded high-purity *Ge detector*; *3"x 3" NaI(Tl)* detectors; *Si(Li) x-ray* detector; sealed thin-window *Xe proportional* counter tube; *surface-barrier* detectors; *4π-beta-ray* counter; *2π-beta-ray* counter with anticoincidence shielding counter; two *methane proportional counters with screening counters* for dating using the *conventional $^{14}$C method*; various types of *ionisation chambers*

operated in current mode and a solid state detection system for measurements of *radon and thoron and their daughters*, an *electrete* measuring device for the same purpose; the universal *spectra-analysis program* "IRUK" [developed by H. Friedmann] for use on PCs (including peak search and macro programming).

4. Other projects

a) *Program to evaluate and check the reliability of the half-life values of some long-lived radionuclides("How well do we know our clocks"*)
relevant to archaeochronology, geochronology and cosmochronology
[compare, e.g., F. Begemann et al., Call for an improved set of decay constants for geochronological use, Geochim. Cosmochim. Acta 65 (2001) 111-121].
In addition, the basic question of the change of half-lives due to stellar environments or other extreme environmental conditions will also be discussed.

b) *Re-evaluation* of experimental data for the *half-lives of the uranium isotopes* $^{235}U$ *and* $^{238}U$
[R. Schön, G. Winkler, W. Kutschera]

c) *Austrian National Radon Project (ÖNRAP)* [H. Friedmann]:
The Austrian Radon Project (ARP) started in 1992 and ended in 2002. The aim of the project was to determine the radon exposure of the population in Austria as well as to classify areas according to their potential radon risk from the ground. The observed radon concentration does not reflect in all cases the radon risk from the ground because of different dwelling situations, house types, maintenance, and living conditions. Therefore, the ARP had two aims: firstly finding areas with houses of enhanced indoor radon concentrations for future radon mitigations and secondly defining areas with elevated radon risk where radon safe construction is necessary for new houses. The project was carried out by systematic indoor measurements in randomly selected houses using different types of detectors. A radon potential was derived from the results of these measurements and the information received from additional questionnaires. This radon potential was defined as an expected radon concentration in a standard situation and shall characterise the radon risk from the ground without the influence of different living situations. Expected lung-cancer mortalities were computed on basis of ICRP 65 estimates from mean radon exposure on county level and the results compared with actual lung-cancer mortality. [Final results to be published in 2003].

See also http://www.univie.ac.at/Kernphysik/oenrap/welcome.htm ;
H. Friedmann: Radon in Austria, Proc. 5th Conf. on High Levels of Natural Radiation and Radon Areas, Munich, 4-7 Sep. 2000, Vol. II, BfS- Schriften 24/2002, ISSN-0937-4469, ISBN 3-89701-808-X, Salzgitter 2002.];
also available: "Radon information CD" (H. Friedmann).

d) *Conventional radiocarbon dating* (up to about 40000 years B.P.):
Interdisciplinary co-operation is continued.

5. Work and co-operation on special reports and standard concepts, training tasks

Co-operation with the *Austrian Standards Institute* (OENORM) to achieve a uniform interpretation of low-level measurements and to harmonise measurement-uncertainty statements in radiation protection is continued:

a) ÖNORM S 5250-2: *"Counting statistics in radioactivity measurements - Spectroscopic measurements"* defines the requirements for the treatment of uncertainties in spectroscopic measurements, especially for low-level high-resolution spectroscopy. The decision limit and the lower limit of detection is introduced, procedures for single-peak evaluation and for the evaluation of several peaks produced by a specific radioisotope are treated. Criteria for deciding whether a measured quantity is below or above a (e.g. legally) set value are given. The practical handling of the given rules is demonstrated by examples. The program is to be extended to the certification of drinking water.

b) OENORM S5280-1 and OENORM S5280-2: *"Radon-measurement methods and their range of applications"* and *"Civil engineering precautionary measures in the case of buildings"* (Austrian Standard for indoor radon measurements and for a certification of dwellings).

Students' training in the field of general experimental physics, quantum physics, atomic physics, nuclear physics, ion physics and radioactivity measurements is taken care of by the staff of the IIK.

6. Participation in international organisations

- International Committee for Radionuclide Metrology (ICRM) [G. Winkler];
- Consultative Committee for Ionising Radiation (CCRI), Section II (Measurement of Radionuclides) at the BIPM, Sèvres, France [member: G. Winkler];
- Science and Technology Committee, EURATOM [delegate P. Hille];

February 2003 Gerhard Winkler

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| LABORATORY | EC-JRC Institute for Reference Materials and Measurements |
| NAMES | M. Hult, R. Vasselli, J. Gasparro* |
| APPARATUS | Four ultra low background HPGe detectors, placed in the underground laboratory HADES at 225 m below sea level (500 m w.e.).<br>50 % relative efficiency planar HPGe-detector<br>8 % relative efficiency semiplanar HPGe-detector<br>3. 60% relative efficiency coaxial HPGe-detector<br>4. 106% relative efficiency coaxial HPGe-detector<br>All detectors are placed inside specially designed shields made from electrolytic copper and low activity lead. There is a 5$^{th}$ lead/copper-shield installed. It is designed to house different detectors and can be used e.g. to test detectors for their inherent radioactivity. |
| RESULTS | 1. Measurement of $^{60}$Co in German steel<br>2. Measurement *in vitro* of $^{210}$Pb in human lung tissues<br>3. Measurement of $^{60}$Co in spoons activated by neutrons during the JCO criticality accident in 1999<br>4. Measurement of swipe samples from nuclear installations |
| IN PROGRESS | 1. Measurement of $^{210}$Pb in human bones<br>2. Environmental neutron fluence measurements using activation foils<br>3. Materials selection for BOREXINO<br>4. Measurement of $^{60}$Co in steel samples from Hiroshima<br>5. Improvement of background reduction. |
| PUBLICATIONS | M. Hult M, M.J. Martinez, P.N. Johnston and K. Komura, J. Environ. Radioactivity, **60**, 3 (2002) pp.307-318.<br>C. Arpesella, *et al.* (Borexino Collaboration). Astroparticle Physics, **18** (2002) pp. 1-25.<br>P. Reimer *et al.* Nucl. Phys. A, **705** (2002), pp 265-278.<br>M. Hult *et al.*,"Ultra Sensitive Measurements of Gamma-ray Emitting Radionuclides using HPGe-detectors in the Underground Laboratory HADES", to be published in a journal of Royal Society of Chemistry. |

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| OTHER RELATED PUBLICATIONS | M. Hult, ”Information on IRMM measurements carried out in the underground laboratory HADES 1999-2002”, Internal Report at IRMM, GE/R/RN/03/02. |
| ADDRESS | European Commission<br>Joint Research Centre<br>Institute for Reference Materials and Measurements (EC-JRC-IRMM)<br>Retieseweg,<br>B-2440 Geel, Belgium<br>Tel: +32 (0)14 57 12 69, Fax.: +32 (0)14 58 42 73,<br>Email: mikael.hult@irmm.jrc.be |
| CONTACT | Mikael HULT |

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| LABORATORY | EC-JRC-IRMM<br>JRC Reference Laboratory for Radionuclide Metrology |
| NAMES | S. Pommé, G. Sibbens, T. Altzitzoglou, R. Van Ammel, L. Johansson, T. Szabo, B. Denecke, D.F.G. Reher |
| APPARATUS<br>ACTIVITY | 4π pressurised gas proportional counter<br>windowless 4πCsI(Tl)-sandwich spectrometer<br>two α-particle counters at defined solid angle<br>atmospheric 4πβ–γ coincidence counter<br>pressurised 4πβ–γ coincidence counter<br>4πγ NaI well counter<br>two secondary standard ionisation chambers<br>two 4π liquid scintillation counters |
| RESULTS | Standardisation of $^{32}$P and $^{204}$Tl (CCRI key comparison).<br>Activity measurement of $^{233}$U in a $^{233}$Pa source. |
| IN PROGRESS | Standardisation of $^{232}$U, $^{236}$Pu and $^{229}$Th tracers used for re-certification of IAEA reference materials.<br>Standardisation of $^{192}$Ir.<br>Standardisation of $^{65}$Zn.<br>Introduction of a new single-parameter and a new multi-parameter data acquisition system using Labview and NI cards. |
| PUBLICATIONS | G. Goeminne, C. Wagemans, J. Wagemans, U. Köster, P. Geltenbort, B. Denecke, L. Johansson, S. Pommé<br>Nucl. Instr. Meth. A. **489**, 577 (2002).<br><br>S. Pommé, L. Johansson, G. Sibbens, B. Denecke<br>A practical algorithm for the solid angle calculation applied in □-particle counting, Nucl. Instr. Meth. A<br><br>G. Sibbens, S. Pommé, L. Johansson, B. Denecke<br>Tailoring solid angle calculations to the actual radioactivity distribution of planar sources, Nucl. Instr. Meth. A<br><br>L. Johansson, T. Altzitzoglou, G. Sibbens, S. Pommé, B. Denecke<br>Standardisation of $^{238}$Pu using four different methods of measurements, Nucl. Instr. Meth. A |

ADDRESS EC-JRC-IRMM
Retieseweg
B - 2240 Geel, Belgium
Tel.: +32 (0)14 57 12 11
Fax: +32 (0)14 58 42 73, +32 (0)14 57 18 64
E-mail: stefaan.pomme@irmm.jrc.be

CONTACT Dr. Dr. S. Pommé.

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| LABORATORY | EC-JRC-IRMM<br>JRC Reference Laboratory for Radionuclide Metrology |
| NAMES | G. Sibbens, S. Pommé, T. Altzitzoglou |
| APPARATUS<br>ACTIVITY | High resolution semiconductor alpha-particle spectrometer |
| RESULTS | $^{235}$U source preparation (EUROMET 591). |
| IN PROGRESS | Measurement of nuclear data of $^{235}$U (EUROMET 591).<br>An off-line peak stabilisation method applied to alpha-particle spectrometry.<br>Migration of existing analysis code ALFA to Windows platform.<br>Development of spreadsheet application for deconvolution of alpha-particle spectra.<br>Study of the alpha-particle emission probabilities of $^{240}$Pu. |
| PUBLICATIONS | M.J. Woods, D.H. Woods, S.A. Woods, L.J. Husband, S.M. Jerome, C. Michotte, G. Ratel, M. Crespo, E. Garcia-Torano, L. Rodriguez, A. Luca, B. Denecke, G. Sibbens, J. Morel, M. Etcheverry, D. Santry, H. Janssen, E. Schönfeld, U. Schötzig, Appl. Radiat. Isot. **56,** 415 (2002). |
| ADDRESS | EC-JRC-IRMM<br>Retieseweg<br>B - 2240 Geel, Belgium<br>Tel.: +32 (0)14 57 12 11<br>Fax: +32 (0)14 58 42 73, +32 (0)14 57 18 64<br>E-mail: goedele.sibbens@irmm.jrc.be |
| CONTACT | G. Sibbens. |

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| LABORATORY | European Commission - Joint Research Centre<br>Institute for Reference Materials and Measurements (IRMM) |
| NAMES | T. Altzitzoglou |
| APPARATUS | 1. HPGe detector systems (incl. low background detectors)<br>2. Low and Ultra low level liquid scintillation spectrometers<br>3. Facilities for radiochemical separations<br>4. Various instruments for thin foil production and radioactive source preparation. |
| RESULTS | 1. Standardisation of $^{89}$Sr, $^{32}$P (BIPM international comparisons).<br>2. Standardisation of $^{204}$Tl and absorption tests in solid sources.<br>3. Characterisation of the NIST Ocean Shellfish (future SRM-4358). |
| PUBLICATIONS | 1. L. Johansson, G. Sibbens, T. Altzitzoglou, and B. Denecke "Self-absorption correction in standardization of $^{204}$Tl", Appl. Radiat. Isot. **56**, 199 (2002).<br>2. P. Johnston, M. Hult, and T. Altzitzoglou "Measurement of low levels of $^{26}$Al from meteorite samples", Appl. Radiat. Isot. **56**, 399 (2002).<br>3. T. Altzitzoglou, B. Denecke, L. Johansson and G. Sibbens "Standardisation of $^{89}$Sr using three different methods", Appl. Radiat. Isot. **56**, 447 (2002). |
| IN PROGRESS | 1. Characterisation of the IAEA-152 (Milk powder) and IAEA-375 (Soil) RMs using radiochemical methods.<br>2. Measurement of tritium, gross alpha and gross beta in drinking water.<br>3. Standardisation of $^{192}$Ir, $^{65}$Zn (BIPM international comparisons). |
| ADDRESS | European Commission<br>Joint Research Centre<br>Institute for Reference Materials and Measurements (IRMM)<br>Retieseweg, B-2440 Geel, Belgium<br>Tel. +32 14 571266 - Fax +32 14 584273<br>E-mail: altzitzoglou@irmm.jrc.be |
| CONTACT | Timos Altzitzoglou |

LABORATORY SCK·CEN, Safeguards and Nuclear Physics Measurements (SA1/SA2)

NAMES M. Bruggeman, J.L. Genicot, J. Paepen, P. Vermaercke, P. Willeborts

APPARATUS
- Low-level HPGe coaxial and planar detectors
- Particle detectors, X-ray detectors
- NaI(Tl) detectors ( cylindrical and well-type)
- Shielded rooms
- $4\pi\beta\gamma$-coincidence, $4\pi\gamma$–counting, $2\pi\alpha$–counting
- Neutron coincidence and multiplicity counting
- BR1 reactor and rabbit system for Neutron Activation Analysis

ACTIVITY
- $\alpha$- and $\gamma$–spectrometry
- Preparation of Radioactive Standards
- Whole body and organ counting
- Neutron activation analysis with $k_0$ - method
- Non-destructive assay of nuclear wastes and special nuclear material ($\gamma$–spectrometry and neutron counting)

RESULTS We developed a passive neutron coincidence counter, the H2K, for waste assay capable of measuring 1 mg of Pu in a 220 l waste package filled with concrete rubble. The system uses digital filtering of counts and applies corrections for the variations in atmospheric pressure influencing the neutron background. The acquisition and analysis is based on the in house developed NeuTICS software.

Through the participation in the AQCS inter-laboratory tests, the Laboratory for Gamma spectrometry became a member of the ALMERA network.

We developed an analysis program, PANCALC, for the non-destructive assay of waste packages for the IPAN/GEA assay system to be used in the measurement range up to 200 Pu per waste package.

We co-organised two WGA (Working Group A) meetings of ENTRAP (European Network for Testing facilities of Radioactive waste Packages) together with CEA Cadarache (Cadarache, June 2002), and together with ARC (Vienna, October 2002). WGA deals with quality checking of nuclear wastes via Non-destructive assay techniques.

PUBLICATIONS J. Botte, P. Luycx, M. Bruggeman, "Extension of the Measurement Range of the IPAN/GEA System from mg Pu to 200 g Pu for the Non-Destructive Assay of 200 l and 400 l Waste Packages", Presentation at the 4th International Seminar on Radioactive Waste Products, Würzburg, 2002.

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| | M. Bruggeman, J. Paepen, W. De Boeck, R. May, R. Strange, "Independent Quality Checking of UK LLW for Plutonium using the SCK•CEN Hexagon 2000 Passive Neutron Coincidence Counter", Presentation at the 4th International Seminar on Radioactive Waste Products, Würzburg, 2002.<br>C. Lierse1, M. Bruggeman, A. Gonzalez de la Huebra, S. Daish, T. McMenamin, "EN-TRAP the European Network of Testing Facilities for the Quality Checking of Radioactive Waste Packages.", Presentation at the 4th International Seminar on Radioactive Waste Products, Würzburg, 2002.<br>J.L. Genicot, I. Geboers, A. Damen, Room Temperature Semiconductor Detector Arrays for in-vivo Assessment of Radionuclides in the Body. Satellite Meeting International Conference - Jaipur, India – Feb. 26-27, 2001.<br>J.L. Genicot, I. Geboers, A. Damen, D. Franck, L. de Carlan *The Reduction of limits of detection in In-Vivo Counting of Low Energy Photon Emitters by optimizing the shape and size of detectors.* Workshop on Internal Dosimetry of Radionuclides. Oxford, U.K. September 9-12, 2002 |
| IN PROGRESS | Research on the use of room temperature semi-conductor diodes for whole body counting;<br>Development of software for gamma-ray efficiency calibration for arbitrary geometry, allowing corrections for sample composition, and true coincidence summing effects including a least squares module for the optimisation of problem parameters, given experimental data. |
| OTHER RELATED PUBLICATIONS | M. Bruggeman et al, "Improvement of Passive and Active Neutron Assay Techniques for the Characterization of Radioactive Waste Packages", Proceedings "Past, Present and Future of QA/QC on Radioactive Waste", p. 5-9, Petten, 2000, WG-A-03, 2002. |
| ADDRESS | Safeguards and Nuclear Physics Measurements<br>SCK•CEN, Boeretang 200, B-2400 Mol Belgium<br>Telephone: (+32-14) 33 28 86<br>Fax: (+31-14) 32 10 56<br>E-mail: mbruggem@sckcen.be<br>Web: http://www.sckcen.be/research/radiationprotection/kernfys/<br>Web: http://www.sckcen.be/research/radiationprotection/safeguards/ |
| CONTACT | M. Bruggeman |

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| LABORATORY | SCK.CEN, Nuclear Chemistry & Services (SA1/SA2) |
| NAMES | L. Vandevelde, M. Gysemans, M. Van Bocxstaele, P. Van Bree |
| ACTIVITY | Destructive analyses of matrix elements and impurities in fresh and spent nuclear fuels, reactor dosimeters, reactor materials, radioactive wastes and geological samples.<br><br>Determination of the isotopic composition of U and Pu, and of the U, Pu and $^{241}$Am concentration in fuels (accredited according to ISO17025).<br><br>Burn-up analyses of spent fuels. |
| IN PROGRESS | Development and validation of ICP-MS methods for the analysis of radioactive materials using a nuclearised instrument. |
| ADDRESS | Nuclear Chemistry & Services<br><br>SCK•CEN<br>Boeretang 200, B-2400 Mol, Belgium<br>Telephone : (+32-14) 33 32 07<br>Telecopier : (+32-14) 32 07 55<br>E-mail : mgyseman@sckcen.be<br>Web:http://www.sckcen.be/research/radiowastecleanup/nuclchem/anal_appl_radiochem.html |
| CONTACT | M. Gysemans. |

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| LABORATORY | SCK·CEN, Low Level Radioactivity Measurements (SA1/SA2) |
| NAMES | C. Hurtgen, F. Verrezen. |
| APPARATUS | ▪ ZnS alpha counters<br>▪ Proportional counters<br>▪ Liquid scintillation counters<br>▪ alpha spectrometers |
| ACTIVITY | Gross alpha and beta, $^{3}H$, $^{14}C$, $^{89-90}Sr$, $^{131}I$, $^{210}Po$, $^{226}Ra$ and actinides activity measurements in environmental samples<br>Assay of actinides ( Th, U, Pu, Am...) in biological samples (urine, faeces) and environmental samples (water, sediment, soil ...) by alpha spectrometry.<br>Assay of $^{14}C$, $^{63}Ni$, $^{99}Tc$, $^{129}I$ in low level waste |
| PUBLICATIONS | Verrezen, F. and C. Hurtgen, "Low Level Scintillation Counting in a Deep Underground Laboratory: Background Reduction Aspects." 9th International Symposium on Environmental Radiochemical Analysis, Maidstone, U.K. 18-20 september 2002<br>Hurtgen, C., P. Bérard and Cossonnet, C. "A survey on uncertainty in bioassay measurements carried out within the OMINEX project." Workshop on Internal Dosimetry of Radionuclides Occupational, Public and Medical Exposure, Oxford. 9-2 September 2002. |
| IN PROGRESS | Extending the QA system following EN45001 / ISO17025 norm to obtain accreditation for bioassay and environmental measurements by alpha spectrometry. |
| ADDRESS | Low Level Radioactivity Measurements<br>SCK•CEN<br>Boeretang 200<br>B-2400 Mol Belgium<br>Telephone: (+32-14) 33 28 31<br>Telecopier: (+32-14) 32 10 56<br>E-mail: churtgen@sckcen.be<br>Web: http://www.sckcen.be/research/radiationprotection/lrm/ |
| CONTACT | C. Hurtgen |

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| LABORATORY | Laboratório Nacional de Metrologia das Radiações Ionizantes LNMRI/IRD/CNEN |
| NAMES | A. Iwahara, A.E. de Oliveira, C.J. da Silva, E.M.O. Bernardes, J. dos S. Loureiro, L. Tauhata, M.A.R.R. di Prinzio, P.A.L. da Cruz and R. Poledna. |
| ACTIVITY | $4\pi\beta$(PPC)-$\gamma$(Ge) and $4\pi\beta$(PC)-$\gamma$(NaI(Tl)) coincidence systems, $4\pi\gamma$ ionization chambers, WALLAC liquid scintillation counter. |
| RESULTS | 1- Standardization of $^{32}$P, $^{204}$Tl solutions.<br>2- Traceability program with hospitals. |
| PUBLICATIONS | C. J. da Silva, A. Iwahara, J.U. Delgado, L. Tauhata, R. Poledna, and R. N. Alves, Absolute determination of activity per mass and half-life measurements of $^{152}$Eu., Appl. Radiat. Isot., 56 / 1,2 (2002) 169-172.<br><br>A. Iwahara, A. E. de Oliveira, L. Tauhata, C. J. da Silva, P. G. da Silva, A. M. S. Braghirolli and R. T. Lopes, Performance of a dose calibrators in Brazilian hospitals for activity measurements, Appl. Radiat. Isot., 56 / 1,2 (2002) 489-496.<br><br>P. A. L. Cruz, J. S. Loureiro and E. M. O . Bernardes, Standardization of a $^{89}$Sr solution from a BIPM intercomparison using a liquid scintillation method, Appl. Radiat. Isot., 56 / 1,2 (2002) 457-459. |
| IN PROGRESS | Standardization of $^{241}$Am, $^{65}$Zn and $^{192}$Ir solutions. |
| SOURCE IN PREPARATION | A Iwahara, A. E. De Oliveira, L. Tauhata, R. T. Lopes, M. A. L. da Silva, Berdj A. Megueirian, Analysis of the performance of a radionuclide calibrator for activity measurements, submitted to Journal of Nuclear Medicine Technology. |
| ADDRESS | Instituto de Radioproteção e Dosimetria, Av. Salvador Allende, s/n, Recreio, CEP 22780-160, Rio de Janeiro, Brazil.Tel: ++55 21 3411 8179 Fax: ++55 21 2442 1605 E.mail: iwahara@ird.gov.br |
| CONTACT | A.Iwahara |

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| LABORATORY | Laboratório Nacional de Metrologia das Radiações Ionizantes LNMRI/IRD/CNEN |
| NAMES | E.M.O. Bernardes, J.U. Delgado, L. Tauhata, M.A.R.R. di Prinzio, P.A.L. da Cruz Antonio E. De Oliveira and R. Poledna. |
| ACTIVITY | X and γ-ray spectrometry |
| RESULTS | 1 - Half-life determination of radiopharmaceuticals.<br><br>2 - Impurity study by gamma-ray spectrometry. |
| PUBLICATIONS | J.U. Delgado, J. Morel, M. Etcheverry, Measurements of photon emission probabilities from the decay of $^{226}$Ra and daughters, Appl. Radiat. Isot., 56 / 1,2 (2002) 137-143.<br><br>E. M. B. de Oliveira, J.U. Delgado, L. Tauhata, C. J. da Silva, A. Iwahara, R. Poledna, A.S. Paschoa, $^{166m}$Ho a multi-γ standard for the calibration of Ge spectrometers, to be published in Appl. Radiat. Isot., 56 / 1,2 (2002) 157-161. |
| IN PROGRESS | Measurements of nuclear data paratmeters in the standardization of $^{241}$Am, $^{65}$Zn, $^{109}$Cd and $^{192}$Ir, $^{201}$Tl solutions. |
| SOURCE IN PREPARATION | M.A.L. da Silva, M.C.M. de Almeida e J.U.Delgado, Determination of the half-life of the radiopharmaceuticals by reference source method, submitted to ICRM meeting.<br><br>K.C. de Souza, M.A.L. da Silva, J.U.Delgado, P.A.L. da Cruz, E.M.O. Bernardes and T.T.Lopes, Photon Emission probabilities $^{109}$Cd spectrometry, submitted to ICRM meeting. |
| ADDRESS | Instituto de Radioproteção e Dosimetria, Av. Salvador Allende, s/n, Recreio, CEP 22780-160, Rio de Janeiro, Brazil.Tel: ++55 21 3411 8173 Fax: ++55 21 2442 1605 E.mail: delgado@ird.gov.br |
| CONTACT | J. U. Delgado |

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| LABORATORY | Laboratório Nacional de Metrologia das Radiações Ionizantes LNMRI/IRD/CNEN |
| NAMES | M.E.C. Vianna, L. Tauhata, A.E. de Oliveira, A.C.M. Ferreira, Cirilo C.S. Conceição, E.M..O. Bernardes and M. J. C. S. de Bragança. |
| ACTIVITY | 1. Spike sources of beta, alpha and multi-gamma emitters in water matrix.<br><br>2. Samples of sediment and soils taken from Poços de Caldas region in Brazil. |
| RESULTS | 1- Quality control program of environmental laboratorie. |
| PUBLICATIONS | L. Tauhata, M. E. C. Vianna, A. E. de Oliveira, A. C. M. Ferreira, C. C. S. da Conceição, Metrological capability of the Brazilian laboratories of analyses of radionuclides in environmental samples, to be published in Appl. Radiat. Isot. 56 / 1,2 (2002) 409 414 |
| IN PROGRESS | Study of homogenity of soil samples from Poços de Caldas region. |
| SOURCE IN PREPARATION | M. J.C. S. Bragança, L. Tauhata, A. F. Clain, I. Moreira, The use of instrumental neutron activation and multivariate statistic analyses in differentiation of Brazilian phosphate ores, submitted to Journal of Radioanalytical and Nuclear Chemistry. |
| ADDRESS | Instituto de Radioproteção e Dosimetria, Av. Salvador Allende, s/n, Recreio, CEP 22780-160, Rio de Janeiro, Brazil.Tel: ++55 21 3411 8154 Fax: ++55 21 2442 1605 E.mail: tauhata@ird.gov.br |
| CONTACT | L. Tauhata |

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| LABORATORY | Czech Metrology Institute<br>Inspectorate for Ionizing Radiation<br>Prague, Czech Republic |
| NAMES | J. Sochorová , M.Havelka, P. Auerbach, L. Plchová, |
| APPARATUS | 4π(PC)ß-γ coincidence equipment<br>4π(PPC)X,e-γ coincidence equipment<br>4π NaI(Tl) detector<br>4π LS ß-γ coincidence equipment |
| ACTIVITY | Absolute activity measurement.<br>Routine standardization of 25 radionuclides. |
| PUBLICATION | M.Havelka, P.Auerbach, J.Sochorová, Software coincidence counting, Appl. Radiat. Isot., Vol. 56 (2002) 256-258 |
| IN PROGRESS | Development of software coincidence counting system. |
| ADDRESS | ČMI - IIZ<br>Radiová 1<br>102 00 Praha 10<br>Czech Republic<br>tel.: +420 266020497<br>fax: +420 266020466<br>E-mail: pdryak@cmi.cz |
| CONTACT | P. Dryák |

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| LABORATORY | Czech Metrology Institute<br>Inspectorate for Ionizing Radiation<br>Prague, Czech Republic |
| NAMES | P.Dryák, P.Kovář |
| APPARATUS | HPGe and Ge(Li) detectors for gamma spectrometry<br>Si and Si(Li) detectors for alpha and beta spectrometry<br>Si(Li) detector for X-spectrometry<br>MCAs CANBERRA S100, AIM 556A |
| ACTIVITY | Radionuclide impurities measurement<br>Environmental samples measurement<br>Standards production control (activity measurement)<br>Verification, type test and calibration for alpha, beta and gamma spectrometers used in Czech Republic |
| PUBLICATION | P.Dryák, P.Kovář, J.Šuráň, Determination of Correction to True Summations of Photons for Measurement in Marinelli Beakers, Vol. 56 (2002) 111-116 |
| ADDRESS | ČMI - IIZ<br>Radiová 1<br>102 00 Prague 10<br>Czech Republic<br>tel.: +420 266020497<br>fax: +420 266020466<br>E-mail : pdryak@cmi.cz |
| CONTACT | P.Dryák |

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| LABORATORY | Bureau International des Poids et Mesures, Sèvres. |
| NAMES | C. Michotte, G. Ratel, C. Colas, M. Nonis |
| APPARATUS | 1. Ge(Li) spectrometer (11 %).<br>2. HPGe spectrometer (20 % XtRa)<br>3. Gas flow 4π proportional counter<br>4. Gas flow 4π pressurized proportional counter<br>5. LS spectrometer |
| RESULTS | 1. Impurity checks of SIR ampoules with the Ge(Li) detector and study of the influence of these results on the SIR measurements.<br>2. Participation in the $^{241}$Am international comparison of activity measurement, using the 4π(PC)α–γ coincidence method and liquid-scintillation techniques.<br>3. Participation in the $^{32}$P, $^{204}$Tl and $^{65}$Zn international comparison of activity measurement using liquid-scintillation techniques. |
| PUBLICATIONS | C. Michotte, *Efficiency curve of the ionization chamber of the SIR,*<br>Appl. Radiat. and Isot. 56 (2002) 15-20. |
| IN PROGRESS | 1. Efficiency calibration of the HPGe spectrometer using Genie 2000 for the data acquisition, a home-made Linear Gate and Fitzpeaks for the spectrum analysis.<br>2. Participation in the $^{192}$Ir international comparison of activity measurement using the 4π(PPC)β–γ coincidence method. |
| INFORMATION | Final reports of all SIR key comparisons are in progress. Seventeen reports have already been published in the Metrologia Technical Supplements and are available on the BIPM/KCDB web site. |
| ADDRESS | BIPM<br>Rayonnements ionisants<br>Pavillon de Breteuil<br>F-92312 Sèvres cedex France<br>Telephone: (33-1) 4507 7070 Fax: (33-1) 45 34 20 21<br>e-mail: cmichotte@bipm.org and gratel@bipm.org |
| CONTACT | C. Michotte and G. Ratel |

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| LABORATORY | Bureau International des Poids et Mesures, Sèvres. |
| NAMES | C. Michotte, G. Ratel, C. Colas, M. Nonis |
| ACTIVITY | 1. Organisation of the international comparison of activity measurements of $^{192}$Ir<br>2. Organisation of the international comparison of activity measurements of $^{65}$Zn<br>3. Organisation of the international comparison of activity measurements of $^{54}$Mn |
| ADDRESS | BIPM<br>Rayonnements ionisants<br>Pavillon de Breteuil<br>F-92312 Sèvres cedex France<br>Telephone: (33-1) 4507 7070 (direct : 7086)<br>Fax: (33-1) 45 34 20 21<br>e-mail: gratel@bipm.org |
| CONTACT | G. Ratel |

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| LABORATORY | Bureau International des Poids et Mesures, Sèvres. |
| NAMES | C. Michotte, G. Ratel, C. Colas, M. Nonis |
| APPARATUS | Three-photomultiplier liquid-scintillation spectrometer |
| IN PROGRESS | Start of routine measurements |
| ADDRESS | BIPM<br>Rayonnements ionisants<br>Pavillon de Breteuil<br>F-92312 Sèvres cedex France<br>Telephone: (33-1) 4507 7070 (direct : 7086)<br>Fax: (33-1) 45 34 20 21<br>e-mail: gratel@bipm.org |
| CONTACT | G. Ratel |

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| LABORATORY | Bureau International des Poids et Mesures, Sèvres. |
| NAMES | C. Michotte, G. Ratel, C. Colas, M. Nonis |
| IN PROGRESS | SIR Monographie |
| ADDRESS | BIPM<br>Rayonnements ionisants<br>Pavillon de Breteuil<br>F-92312 Sèvres cedex France<br>Telephone: (33-1) 4507 7070 (direct : 7086)<br>Fax: (33-1) 45 34 20 21<br>e-mail: gratel@bipm.org |
| CONTACT | G. Ratel |

(SA1/SA2)

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| LABORATORY | BNM-Laboratoire National Henri Becquerel |
| NAMES | M.M. Bé, V. Chisté, C. Dulieu |
| ACTIVITY | Evaluation of Radionuclide Decay Data |
| RESULTS | - evaluation of $^{59}$Fe, $^{11}$C, $^{15}$O, $^{123}$Te$^{m}$, $^{13}$N<br>- opening of a website dedicated to the Decay Data Evaluation Project at the address : http: //www.bnm.fr/bnm-lnhb/nucdata.htm |
| PUBLICATIONS | M.M. Bé, E. Schönfeld, J.Morel<br>Evaluation of $^{169}$Yb decay data , Applied Radiation Isotopes 56 (2002) 181<br><br>M.M. Bé, R. Helmer, V. Chisté<br>The NUCLÉIDE database for decay data and the "International Decay Data Evaluation Project", Journal of Nuclear Science and Technology, Supplement 2 (August 2002) 481<br><br>R. Helmer, E. Browne, M.M. Bé<br>International Decay Data Evaluation Project, Journal of Nuclear Science and Technology, Supplement 2 (August 2002) 455<br><br>C. Bonnelle, P. Jonnard, M.-M. Bé, M.-C. Lépy<br>Emissions X K du manganèse : comparaison entre les spectres du métal et d'une source de $^{55}$Fe, Bulletin du BNM 2001-2, 120 (2002) 7 |
| IN PROGRESS | A new volume of the "Table de radionuclides" with the related comments |
| OTHER RELATED PUBLICATIONS | M.M. Bé, V. Chisté, C. Dulieu<br>Participation du LNHB au groupe de travail AIEA : "Update of X-ray and gamma-ray standards for detector calibration and other applications". Report DIMRI/LNHB/02-25 (2002) |
| ADDRESS | DRT/DIMRI/LNHB<br>CEA-Saclay<br>F- 91191 Gif sur Yvette Cedex<br>Tel : 33 1 69 08 46 41<br>Fax : 33 1 69 08 95 29<br>E-mail : mmbe@cea.fr |
| CONTACT | Marie-Martine Bé |

(SA1/SA2)

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| LABORATORY | BNM-Laboratoire National Henri Becquerel |
| NAMES | M.N. Amiot, J.B. Adamo |
| APPARATUS | Calibrated 4πγ ionisation chamber |
| ACTIVITY | Well type NaI(Tl) scintillation detector |
| | Monte Carlo calculations for the determination of the ionisation chamber response to photon. |
| | Participating in international intercomparison of activity measurements organized by BIPM. |
| | Standardization of radioactive sources and solutions |
| | Half life measurements |
| RESULTS | Monte Carlo simulation of the Vinten 671 ionisation chamber for the calibration factors calculation for gamma emitters. |
| | Participation to the international intercomparison of $^{18}F$ |
| | Standardization of $^{154}Eu$ and $^{134}Cs$ |
| | Measurement of $^{65}Zn$ and $^{88}Y$ half life |
| IN PROGRESS | Monte Carlo simulation of the Vinten chamber for electrons |
| | Participation to the international intercomparison of $^{90}Y$ |
| | Measurement of $^{139}Ce$ and $^{54}Mn$ half life |
| | Standardization of $^{192}Ir$ |


ADDRESS

DRT/DIMRI/LNHB
CEA-Saclay
F-91191 Gif sur Yvette Cedex, FRANCE
Tel : 33 1 69 08 36 89
Fax : 33 1 69 08 26 19
E-mail : marie-noelle.amiot@cea.fr

CONTACT

Marie-Noëlle Amiot

(SA1/SA2)

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| LABORATORY | BNM – Laboratoire National Henri Becquerel |
| NAMES | E. Leblanc, M. Loidl, J. Bouchard |
| APPARATUS ACTIVITY | Cryogenic detectors |
| RESULTS | Development of a 4-π geometry detection bolometer prototype with detection efficiency greater than 99 % for photons and electrons between 100 eV and 6.5 keV. |
| IN PROGRESS | Integration of cool FET electronics<br>Investigation of magnetic microcalorimeters |
| SOURCE IN PREPARATION | "High energy resolution X-ray and gamma ray spectroscopy with cryogenic detectors", to be published in Bulletin du BNM, 2003 |
| ADDRESS | DRT/DIMRI/LNHB<br>CEA-Saclay<br>F-91191 Gif-sur-Yvette Cedex<br>FRANCE<br>Tel : 33 1 69 08 23 32<br>Fax : 33 1 69 08 26 19<br>E-mail : Elvire.Leblanc@cea.fr |
| CONTACT | ELVIRE LEBLANC |

(SA1/SA2)

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| LABORATORY | BNM- Laboratoire National Henri Becquerel |
| NAMES | M.C. Lépy, J. Plagnard. |
| ACTIVITY | X-ray spectrometry |
| RESULTS | Efficiency and peak shape calibration of Si(Li) and HPGe detectors in the 1-10 keV energy range |
| | Characterization of a tunable monochromatic X-ray source (1-20 keV) |
| IN PROGRESS | Measurement of linear attenuation coefficients for photons with energy < 10 keV |
| | Tests of the ETNA code (efficiency transfer and coincidence summing corrections for gamma-ray spectrometry) |
| SOURCE IN PREPARATION | "Study of the response function of low-energy X-ray spectra obtained with an HPGe detector"<br>M.C. Lépy, J. Plagnard, L. Ferreux |
| | Submitted to Nucl. Instrum. and Meth. |
| ADDRESS | DRT/DIMRI/LNHB<br>CEA-Saclay<br>F-91191 Gif-sur-Yvette cedex, FRANCE<br>Tel : 33.1.69.08.24.48<br>Fax : 33.1.69.08.26.19 |
| | E-mail : marie-christine.lepy@cea.fr |
| CONTACT | Marie-Christine Lépy |

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| LABORATORY | BNM-Laboratoire National Henri Becquerel (SAI/SA2) |
| NAME | G. Moutard, M.G. Iroulart, I. Le Garrérès. |
| ACTIVITY | Organisation of national and international interlaboratory comparisons in the field of activity measurements.<br>An opened intercomparison program is proposed every year by BNM-LNHB. |
| APPARATUS | Calibrated HPGe, NaI(Tl), Liquid scintillation counters,<br>Well-type Ionisation chamber with standard electronics and computers |
| RESULTS | The proposed program for the year 2002 was:<br>Activity measurement of a solution of $^{99}Tc^{m}$ (about 370MBq)<br>Activity measurement of $^{90}Sr^{+90}Y$ solutions (about 800 kBq/g, 40 Bq/g, 4 Bq/g)<br>Activity measurement of tritiated water solutions (about 40 kBq/g, 4 Bq/g)<br>Determination of gamma emission rates and activity measurement of $^{152}Eu$ solutions (about 800 kBq/g, 40 Bq/g and 4 Bq/g).<br>Measurement by gamma spectrometry of the activity concentration in solutions containing several radionuclides (about 20 kBq/g, 1 Bq/g) |
| IN PROGRESS | The proposed program for the year 2003 is:<br>Activity measurement of a solution of $^{131}I$ (about 370MBq)<br>Activity measurement of $^{239}Pu$ solutions (about 40 Bq/g, 4 Bq/g, 4 Bq/kg)<br>Separation and activity measurement of $^{3}H$ and $^{90}Sr$ (about 1 Bq/g each) in a solution simulating a radioactive waste also containing $^{137}Cs$ and $^{241}Am$ (respectively about 2 Bq/g and 0,2 Bq/g)<br>Measurement by gamma spectrometry of the activity concentration in solutions containing several radionuclides (about 20 kBq/g, 1 Bq/g) |
| ADDRESS | DRT/DIMRI/LNHB<br>CEA-Saclay<br>F-91191 Gif-sur-Yvette Cedex, France<br>Tel. 33 1 69 08 43 75<br>Fax. 33 1 69 08 26 19<br>E-Mail. gerard.moutard@cea.fr |
| CONTACT | G. Moutard |

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| LABORATORY | Physikalisch-Technische Bundesanstalt |
| NAMES | A. Honig, E. Gargioni, A. Röttger and T. Reich |
| APPARATUS ACTIVITY | PTB, Calibration of active radon monitors. Exposition of passive dosimeters.<br>Installation of Radon flow through gas source.<br>International intercomparison for the radon activity concentration has become an Euromet Project. |
| RESULTS | $c(^{222}Rn)$ from 1 kBq/m$^3$ to 100 kBq/m$^3$, $F$ from 0.1 to 1.0,<br>$f_p$ from 0.01 to 0.9. |
| PUBLICATIONS | G. Butterweck, Ch. Schuler, A. Paul, A. Honig, R. Dersch, V. Schmidt, P. Hamel, H. Buchröder, A. Rox, W. Herzog: *Intercomparison exercise of the PTB, BfS, MPA and PSI calibration facilities for radon gas concentration.* In: Radiation Protection Dosimetry, Vol 98, No 2, pp. 219-222 (2002)<br><br>A. Paul, A. Honig, S. Röttger, U. Keyser: *Metrology of the activity concentration of radon and its progenies at the German reference chamber. High Levels of Natural Radiation and Radon Areas.* In: Radiation Dose and Health Effects<br>International Congress Series, ICS 1225, pp. 161-167 (2002) |
| IN PROGRESS | Installation of the new aerosol measurement system at the German radon reference chamber |
| ADDRESS | Physikalisch-Technische Bundesanstalt<br>Section 6.12<br>Bundesallee 100, D-38116 Braunschweig, Germany<br><br>Telephone: +49-531-592-6103<br>Telefax: +49-531-592-8525<br>E-mail: Anja.Honig@ptb.de |
| CONTACT | Anja Honig |

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| LABORATORY | Physikalisch-Technische Bundesanstalt |
| NAMES | E. Gargioni, A. Honig, A. Röttger and T. Reich |
| APPARATUS | Calibration facility for measuring of thoron ($^{220}$Rn) and its progenies. |
| RESULTS | Uniform and stable thoron reference fields with activity concentrations ranging from 1 to 10 kBq/m$^3$ can be produced in a 0.1 m$^3$ reference chamber with a relative standard uncertainty of less than 5%. This is achieved using $^{228}$Th-exhalation sources. |
| IN PROGRESS | Assessment of the $^{228}$Th source exhalation rate. |
| SOURCE IN PREPARATION | E. Gargioni, A. Honig, A. Röttger: Development of a Calibration Facility for Measurement of the Thoron Activity Concentration. In: Nuclear Instrument Method A (submitted 2002) |
| ADDRESS | Physikalisch-Technische Bundesanstalt<br>Section 6.12<br>Bundesallee 100, D-38116 Braunschweig, Germany<br><br>Telephone: +49-531-592-6102<br>Telefax: +49-531-592-8525<br>E-mail: Elisabetta.Gargioni@ptb.de |
| CONTACT | Elisabetta Gargioni |

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| LABORATORY | Physikalisch-Technische Bundesanstalt |
| NAMES | K. Kossert |
| APPARATUS | Liquid scintillation counter |
| ACTIVITY | Activity measurements (e.g. international intercomparisons of $^{204}$Tl, $^{32}$P, $^{65}$Zn, $^{192}$Ir, $^{90}$Y and $^{241}$Am)<br>Measurement of the half-life of $^{90}$Y<br>Development of a program code to calculate the detection efficiency for nuclear disintegrations accompanied by photons ($\gamma$ or X-Ray) using the databases of XCOM (above 1 keV) and FFAST (below 1 keV). We differentiate between coherent and incoherent photon scattering. Coincidences of photons with $\beta$ or EC transitions can be calculated without approximations even if there are many photons (e.g. $^{192}$Ir).<br>Calculation of the average Auger energy $E_{LXY}$ for EC nuclides and nuclides with converted $\gamma$-transitions<br>Source stability studies |
| RESULTS | Determination of specific activities and impurities of many solutions.<br>Determination of the half-life of $^{90}$Y. |
| IN PROGRESS | Measurement of the half-lives of the long-lived isotopes $^{87}$Rb, $^{147}$Sm and $^{176}$Lu |
| ADDRESS | Physikalisch-Technische Bundesanstalt<br>Section 6.11<br>Bundesallee 100, D-38116 Braunschweig, Germany<br><br>Telephone: +49-531-592-6311<br>Telefax: +49-531-592-6305<br>E-mail: Karsten.Kossert@ptb.de |
| CONTACT | Karsten Kossert |

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| LABORATORY | National Office of Measures (OMH), Radiation Physics Section |
| NAMES | Gy. Hegyi, K. Rózsa, A. Zsinka |
| APPARATUS | $4\pi\beta$-$\gamma$ coincidence counting system. Calibrated $4\pi\gamma$ ionization chamber. $4\pi\beta$ counting system. |
| ACTIVITY | Preparation of radioactive sources for activity measurements. $^{204}$Tl activity measurements by $4\pi\beta$-$\gamma$ coincidence efficiency tracing method ( tracer: $^{134}$Cs) and $^{65}$Zn activity measurements by $4\pi\beta$-$\gamma$ coincidence method (coincidence and anticoincidence counting by a proportional counter for beta plus and EC emission and one gamma-ray channel). |
| RESULTS | Participation in the BIPM CCRI(II) K2. intercomparisons: Standardization of a $^{204}$Tl and $^{65}$Zn solutions. |
| ADDRESS | National Office of Measures<br>H-1535 BUDAPEST, P. O. Box 919.<br>Hungary<br>Phone: (36-1) 458-5800<br>Fax: (36-1) 458-5937<br>E-mail : azsinka@omh.hu |
| CONTACT | András Zsinka |

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| LABORATORY | National Office of Measures (OMH), Radiation Physics Section |
| NAMES | I. Csete, K. Rózsa, L. Szűcs, A. Zsinka |
| APPARATUS | Calibrated gamma spectrometer with HPGe semiconductor detector. Calibrated $4\pi\gamma$ ionization chamber. |
| ACTIVITY | Standardization of $^{m}Tc^{99}$. The types of standards which have been used for efficiency calibration of gamma spectrometer were: $^{109}Cd$, $^{57}Co$, $^{133}Ba$, $^{137}Cs$, $^{54}Mn$, $^{60}Co$ and $^{88}Y$. |
| RESULTS | Participation in the IRS (SIR) program. |
| ADDRESS | National Office of Measures<br>H-1535 BUDAPEST, P. O. Box 919.<br>Hungary<br>Phone: (36-1) 458-5800<br>Fax: (36-1) 458-5937<br>E-mail: L.Szucs@omh.hu |
| CONTACT | László Szűcs |

(SA1/SA2)

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| LABORATORY | Bhabha Atomic Research Centre |
| NAMES | R. Nathuram, Leena Joseph, Anuradha R., D.B. Kulkarni |
| APPARATUS | 1. $4\pi\beta$(P) $\gamma$(NaI) coincidence system.<br>2. Calibrated $4\pi$ Gamma Ion Chamber.<br>3. HPGe detector assembly for $\gamma$-ray spectrometer. |
| ACTIVITY | 1. Participating in international intercomparison programmes of activity measurements organized by BIPM, APMP etc.<br>2. Standardization of radioactive sources and solutions.<br>3. Organizing national intercomparison of activity measurements of $^{131}$I for Nuclear Medicine Centres in the country.<br>4. Gamma ray spectroscopy and activity measurement. |
| RESULTS | 1. Participated in International Intercomparison Programme for activity measurement of $^{204}$Tl and $^{32}$P.<br>2. Standardization of $^{54}$Mn under SIR.<br>3. Supply of standard sources of $^{109}$Cd, $^{137}$Cs, $^{99m}$Tc, $^{131}$I, $^{152}$Eu, $^{201}$Tl, $^{204}$Tl etc. for the users.<br>4. Efficiency factors for HPGe detector for various radionuclides were re-determined. |
| PUBLICATIONS | 1. "Quality Assessment of Isotope Calibrator used in Radioactivity Measurement in Nuclear Medicine Centres", Leena Joseph, Anuradha R., Nathuram R. and Shaha V.V., Annual Conference on Medical Physics & Radiation Safety (AMPICON-2k2), Jaipur, November 2002.<br>2. "Low Energy X-ray Attenuation Coefficient", R. Nathuram, J.B. Shigwan and M. Vijayam, Annual Conference on Medical Physics & Radiation Safety (AMPICON-2k2), Jaipur, November 2002. |
| IN PROGRESS | 1. Standardization of $^{65}$Zn and $^{192}$Ir for International Intercomparison Programme.<br>2. Standardization of $^{22}$Na for SIR. |
| ADDRESS | Head, Radiation Standards Section,<br>RSS Division, BARC,<br>Mumbai 400085, India.<br>Tel: +91 22 5595074<br>Fax: +91 22 5505151<br>e-mail: vvshaha@apsara.barc.ernet.in |
| CONTACT | V.V. Shaha |

(SA1/SA2)

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| LABORATORY | Bhabha Atomic Research Centre |
| NAMES | U.V. Phadnis, V. Sathian, G. Shobha |
| APPARATUS | 4. Manganese Sulphate Bath System.<br>5. Standard Thermal Neutron Assembly in Graphite<br>6. Precision Long Counter.<br>7. Multi-spheres for spectroscopy.<br>8. 4π polythene assembly.<br>9. Activation foils (Threshold detectors).<br>10. He-3 based thermal neutron fluence rate measuring system.<br>11. Neutron rem counter and flux meter.<br>12. Standard neutron sources.<br>13. Water moderator based thermal neutron jig. |
| ACTIVITY | 5. Standardization of radioactive neutron sources.<br>6. Standardization of fluence rate and dose rate.<br>7. Calibration of neutron monitors.<br>8. R&D work associated with neutron standards. |
| RESULTS | 5. Neutron sources were standardized for various users.<br>6. Neutron fluence rate and dose rate were standardized for various users.<br>7. Many neutron monitors were calibrated. |
| IN PROGRESS | 3. Development of Neutron Spectrometer.<br>4. A thermal neutron source for high fluence rate (>$10^5$ nv) is being prepared for the calibration of neutron monitors. |
| INFORMATION | 1. Fast neutron source yield and the thermal neutron fluence rate can be taken up for international intercomparison. |
| ADDRESS | Head, Radiation Standards Section,<br>RSS Division, BARC,<br>Mumbai 400085, India.<br>Tel: +91 22 25595074<br>Fax: +91 22 25505151<br>e-mail: vvshaha@apsara.barc.ernet.in |
| CONTACT | V.V. Shaha |

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| LABORATORY | ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti - Italy |
| NAMES | M. Capogni, P. De Felice, C. Ivan*, M. Sahagia*,<br>L. Grigorescu*<br>* IFIN-HH Bucharest |
| APPARATUS | $4\pi\beta-\gamma$, LS (CIEMAT/NIST) counting equipments |
| ACTIVITY | Standardisation of Am-241 and Zn-65 for BIPM intercomparison |
| IN PROGRESS | Investigation into theoretical problems identified with the standardisations of these radionuclides. Study of experimental aspects concerning source preparation and measurement procedures. |
| ADDRESS | ENEA<br>Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti<br>Centro Ricerche Casaccia<br>P.0.Box 2400 - Roma (Italy)<br>Phone: +39 06 30483580<br>Fax: +39 06 30483558<br>E-mail: defelice@casaccia.enea.it |
| CONTACT | P. De Felice |

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| LABORATORY | ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti - Italy |
| NAMES | M. Capogni, P. De Felice, L. Tarpignati |
| APPARATUS | Liquid scintillation counting equipment |
| ACTIVITY | Experimental study on the use of a commercial liquid scintillation counting system (with Ciemat/Nist method) to develop a high stability/precision transfer standard for BIPM/SIR extension to pure beta emitters. |
| IN PROGRESS | The stability of a Packard Tricarb LSC system is continuously monitored with high stability H-3 and C-14 sources. A set of home-made liquid scintillation cocktails are tested for stability with a number of different radionuclides. |
| ADDRESS | ENEA<br>Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti<br>Centro Ricerche Casaccia<br>P.0.Box 2400 - Roma (Italy)<br>Phone: +39 06 30483580<br>Fax: +39 06 30483558<br>E-mail: defelice@casaccia.enea.it |
| CONTACT | P. De Felice |

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| LABORATORY | ENEA - Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti - Italy |
| NAMES | P. De Felice, L. Volpi |
| APPARATUS | Radon Reference Measurement System and Radon chamber |
| ACTIVITY | Calibration of passive and active radon monitors in radon chamber. Comparison of radon calibration facilities (Euromet Project No. 657) |
| IN PROGRESS | A new radon chamber (about 30 $m^3$) is under construction for the organisation of calibration and intercomparison campaigns on radon measurements for the national environmental radioactivity surveillance network. |
| ADDRESS | ENEA<br>Istituto Nazionale di Metrologia delle Radiazioni Ionizzanti<br>Centro Ricerche Casaccia<br>P.0.Box 2400 - Roma (Italy)<br>Phone: +39 06 30483580<br>Fax: +39 06 30483558<br>E-mail: defelice@casaccia.enea.it |
| CONTACT | P. De Felice |

(SA1/SA2)

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| LABORATORY | Nagoya University |
| NAMES | H. Miyahara, N. Marnada, K. Fujiki, K. Katoh |
| APPARATUS | $4\pi\beta$(ppc)-$\gamma$(HPGe) and $4\pi\beta$(pc)-$\gamma$(HPGe) coincidence apparatus using a live-timed two-dimensional data-acquisition system, and $\gamma$-ray spectrometry system |
| RESULTS | 1. The emission probability for the 2752 and 4296 keV $\gamma$-rays of $^{66}$Ga was measured to be 0.2240(16) and 0.0368(7), respectively.<br>2. The emission probability for the 121 and 197 keV $\gamma$-rays of $^{147}$Eu was measured to be 0.2061(15) and 0.2398(18), respectively. |
| PUBLICATIONS | 1. Determination of Precise Gamma-ray Emission Probabilities for $^{88}$Rb, H. Miyahara et al., Appl. Radiat. and Isot. 56 (2002) 163.<br>2. Determination of the Emission Probabilities of the Principal $\gamma$-rays for $^{134}$Cs to a High Precision, H. Miyahara et al., Appl. Radiat. and Isot. 56 (2002) 131.<br>3. Production of $^{147}$Eu for Gamma-ray Emission Probability Measurement, K. Katoh et al., J. Nucl. Sci. and Technol. 39 (2002) 329.<br>4. Gamma-Ray Emission Probabilities of $^{193}$Os, Nada Marnada et al., Nucl. Instr. and Meth. A480 (2002) 591. |
| IN PROGRESS | The $\gamma$-ray emission probabilities of $^{149}$Eu and $^{69}$Ge that are proton-rich nuclei are measuring.<br>The $\gamma$-ray emission probabilities of $^{80}$Br and $^{105}$Ru that are neutron-rich nuclei are measuring. |
| ADDRESS | Department of Radiological Technology, School of Health Sciences, Nagoya University, 1-1-20 Daikominami, Higashi-ku, Nagoya, 461-8673 JAPAN<br>Telephone 81-52-719-1548,<br>Facsimile 81-52-719-1506<br>E-mail miyahara@met.nagoya-u.ac.jp |
| CONTACT | Hiroshi Miyahara |

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| LABORATORY | National Metrology Institute of Japan, National Institute of Advanced Industrial Science and Technology (NMIJ/AIST) |
| NAMES | Yoshio HINO, Yasushi SATO |
| APPARATUS | $4\pi\beta$(pc)-$\gamma$(NaI) and $4\pi\beta$(ppc)-$\gamma$(Ge) coincidence systems, Calibrated $4\pi\gamma$ ionisation chamber, HP-Ge and Si(Li) detectors, Liquid scintillation system, Imaging analyser system, PIPS for $\alpha$ counting and $2\pi$ multi wire chamber. |
| RESULTS | 1. Participate the CCRI-II Key-comparisons of P-32, Zn-65, Ir-192, Tl-204 and Am-241<br>2. Bilateral base comparison with VNIIM measuring the $\beta$-emitting rate from $^{36}$Cl large area source.<br>3. Trial comparisons for testing the "portability of the calibration factors of ionisation chambers" between several APMP laboratories using $^{166m}$Ho reference sources and small point sources. |
| PUBLICATIONS | Y. Sato and Y. Hino "The new production method of standard surface sources" to be presented in the ICRM'2003 meeting in Dublin |
| IN PROGRESS | 1. Test the new production method of large area sources and low level surface sources for imaging plate calibration.<br>2. Continue the "portability of the calibration factors of ionisation chambers" with several ampoule sources from NMIJ.<br>3. Test the possibility of remote calibration of ionization chambers using computer network system. |
| ADDRESS | Radioactivity and Neutron Standardization Section,<br>Quantum Radiation Division, AIST Tsukuba central-2<br>1-1-1 Umezono, Tsukuba, Ibaraki, 305-8568 JAPAN<br>Tel.: (+81) 298 61 5667, Fax.: (+81) 298 61 5673<br>E-mail : y.hino@aist.go.jp, Web: http://www.aist.go.jp |
| CONTACT | Yoshio HINO |

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| LABORATORY | Radioisotope Centre POLATOM,<br>R & D Department |
| NAME | R. BRODA |
| APPARATUS | 3-PMT liquid scintillator counter, 4π(LS)-γ coincidence and anticoincidence system |
| ACTIVITY | Theoretical calculation of the counting efficiency of the LS-detector. Standardisation of the $^{192}$Ir solution.<br>Participation in the $^{204}$Tl intercomparison organised by BIPM.<br>Contract on the "Assembling and testing a new TDCR system at NIST", NIST, Gaithersburg, Md, USA (40 days).<br>International conference of the European Commission Center of Excelence Interdisciplinary Research and Applications Based on Nuclear and Atomic Physic on the "Applications of high precision atomic & nuclear methods", Neptun, Romania, September 2-6, 2002.<br>Scientific visit in the LNHB and CMI. |
| RESULTS | Correction of the result of $^{192}$Ir standardisation has been made by using of the theoretical model of the 4π(LS)-γ coincidence LS-counter. Mutual verification of the results of the above and the TDCR method reduces a systematic uncertainty. |
| IN PROGRESS | Computing program for application of the TDCR method for standardisation of EC-emitters. Participation in CCRI(II) international comparison: $^{192}$Ir, $^{241}$Am. |
| PUBLICATIONS | A. Chyliński, T. Terlikowska – Drożdźiel, T. Radoszewski, R. Broda (2002). Multi-method of standardisation of radionuclides with triangular scheme of disintegration. Appl. Radiat. Isot., Vol.56, No.1-2, pp.281-284.<br><br>R. Broda, K. Małetka, T. Terlikowska, P. Cassette (2002). Study of the influence of the LS-coctail composition for the standardisation of radionuclides using the TDCR model. Appl. Radiat. Isot., Vol.56, No.1-2, pp.285-289.<br>A.Chyliński, R. Broda, T. Radoszewski (2003). The national standard unit of radionuclide activity and the related standards in Poland. Nucleonika, 48 (1), pp.51-55. |

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| SOURCE IN PREPARATION | R. Broda. Establishing of the National Standard of Radionuclide<br><br>Activity Unit in Poland. (in Polish, accepted for publication in Pomiary Automatyka Robotyka)<br><br>R. Broda. A review of the Triple to Double Coincidence Ratio (TDCR) Method for Standardizing Radionuclides. (accepted for publication in Appl. Radiat. Isot.)<br><br>R. Broda. Statisctics of the LS-detector in case of low counting efficiency. (paper for ICRM'03) |
| ADDRESS | Radioisotope Centre POLATOM<br>05-400 Otwock-Świerk, POLAND<br>Tel: (48 22) 718 07 21, fax: (48 22) 718 03 50<br>e-mail: rbroda@polatom.pl |
| CONTACT | Ryszard BRODA |

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| LABORATORY | Radioisotope Centre POLATOM,<br>Department of Quality Control |
| NAMES | K. MAŁETKA |
| APPARATUS | Gamma spectrometer with HPGe detectors,<br>beta spectrometer WALLAC 1411 |
| ACTIVITY | Measurements of gamma-emitting impurities in different radioactive materials. Activity determinations of beta - pure emitters using LSC - method. Scientific visit in the CMI. |
| IN PROGRESS | Determination of the dose rate and activity of the $^{106}$Re and $^{125}$I ophtalmic applicators. |
| PUBLICATIONS | R. Broda, K. Małetka, T. Terlikowska, P. Cassette (2002). Study of the influence of the LS-coctail composition for the standardisation of radionuclides using the TDCR model. Appl. Radiat. Isot., Vol.56, No.1-2, pp.285-289. |
| ADDRESS | Radioisotope Centre POLATOM<br>05-400 Otwock-Świerk, Poland<br>Tel: (48 22) 718 07 21 fax: (48 22) 718 03 50<br>e-mail: k.maletka@polatom.pl |
| CONTACT | Krzysztof Małetka |

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| LABORATORY | Radioisotope Centre POLATOM,<br>R & D Department |
| NAMES | A. TADRZAK |
| APPARATUS | LS-spectrometer beta Wallac 1411 |
| ACTIVITY | Participation in the intercomparison of $^{204}$Tl and $^{192}$Ir<br>Organised by BIPM.<br>Investigation of the LS-cocktail stability.<br>Preparations of the standard sources and solutions. |
| IN PROGRESS | Elaboration of a new home-made liquid scintillator cocktail |
| ADDRESS | Radioisotope Centre POLATOM<br>05-400 Otwock-Świerk, POLAND<br>Tel: (48 22) 7180722, fax: (48 22) 718 03 50<br>e-mail: A.Tadrzak@polatom.pl |
| CONTACT | Anna TADRZAK |

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| LABORATORY | National Radiation Standard Laboratory, Institute of Nuclear Energy Research (NRSL/INER) |
| NAMES | Ming-Chen Yuan, Jyi-Lan Wuu, Chien-Yung Yeh and Wen-Sung Hwang |
| APPARATUS | $4\pi\beta$(pc)-$\gamma$(NaI) coincidence counting system, |
| ACTIVITY | Standardization of Tl-201 and Re-188 |
| RESULTS | The calibration figure of Tl-201 and Re-188 for ISOCAL-IV chamber are agreement with NPL's result |
| PUBLICATIONS | J.L. Wuu, M.C.Yuan, S.H. Su and W.S. Hwang. (2002). The Alpha and Beta Emitter Measurement System in INER, Applied Radiation and Isotope, *56*, 261-264<br><br>M.C. Yuan, J.H. Lee and W.S. Hwang. (2002). The Absolute Counting of Ho-166m, Co-58 and Y-88, Applied Radiation and Isotope, *56*, 429-434 |
| IN PROGRESS | Standardization of Ga-67<br><br>Set up a LSC system |
| SOURCE IN PREPARATION | Ming-Chen Yuan, Chien-Yung Yeh and Wen-Song Hwang, Standardization of $^{18}$F, $^{201}$Tl and $^{188}$Re radiopharmaceuticals, accepted by ICRM 2003 |
| OTHER RELATED PUBLICATIONS | |
| ADDRESS | Health Physics Division, Institute of Nuclear Energy Research<br><br>1000, Wenhua Road, Chiaan Village, Lungtan, Taoyuan, Taiwan, 325 Republic of Chian<br>E-Mail: mcyuan@iner.gov.tw<br>Fax: +886 3 4714132 |
| CONTACT | Ming-Chen Yuan |

LABORATORY Institutul National de C&D pentru Fizica si Inginerie Nucleara "Horia Hulubei", IFIN-HH

NAMES Maria Sahagia

## ACTION SA1-PLANNED PROGRAM FOR 2003

1. Participation to BIPM key comparisons: $^{54}$Mn, $^{65}$Zn, $^{192}$Ir and $^{241}$Am.
2. Standardization of $^{137}$Cs and $^{241}$Am by two comparative methods: TDCR and coincidence.
3. Assay of a standardization method for $^{222}$Rn.
4. Participation with four papers to ICRM 2003 Conference in Dublin, Ireland.
5. Collaboration with LNHB-Saclay for TDCR method, gas counting and gamma spectrometry ( Ph. Cassette, J. Picolo, J. Morel and M.C. Lepy)
6. Collaboration with dr. R. Broda (POLATOM) on TDCR method (IDRANAP action).
7. Legal qualification of standard sources kits.
8. Issue of standards.
9. Analyses of gamma samples.

## ACTION SA2-REPORT FOR 2002

1. Standardization of a $^{48}$V solution.
2. Participation to BIPM key comparisons: $^{32}$P and $^{204}$Tl.
3. Further development of a TDCR equipment.
4. Participation with 5 papers to the HIPAN02 Conference in Neptun, Romania, organized in the frame of an European Centre of Excelence (IDRANAP Centre, WP7); invited papers were presented by three specialists from France and Poland.
5. Collaboration with LNHB-Saclay for TDCR method, gas counting and gamma spectrometry ( Ph. Cassette, J. Picolo, J. Morel and M.C. Lepy)
6. Obtaining and standardizing a $^{68}$(Ge+Ga) solution, IDRANAP action (post.doc. guest dr. Zoltan Sucsz- Hungary).
7. Coincidence standardization of $^{60}$Co, $^{152}$Eu, $^{241}$Am solutions, IDRANAP action (post.doc. guest dr. Marco Capogni- ENEA-Italy).
8. Coincidence standardization of a $^{65}$Zn solution (ENEA-Italy fellowship for Dr. Maria Sahagia)
9. Issue of standards of different types.
10. Calibration of medical dose calibrators.
11. Analyses of environmental and technological gamma samples.

ADDRESS IFIN-HH, str. Atomistilor 407, Com Magurele, jud. Ilfov,
POB MG-6,
76900, Romania,
tel (4021) 404 23 50,
fax : (4021) 457 44 32/ 457 44 40
e-mail: msahagia@ifin.nipne.ro

CONTACT: Maria Sahagia

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| LABORATORY | IFIN-HH, Radionuclide Metrology Laboratory and ENEA-INMRI, Italy |
| NAME | E.L.Grigorescu, Maria Sahagia, A.C. Razdolescu, C.Ivan, A. Luca, D.Negut, P. De Felice, M.Capogni |
| APPARATUS | 4πPC-γ coincidence installation |
| RESULTS | Preparation of sources to be standardized by 4πPC-γ method and standardization of $^{68}$(Ge+Ga) and $^{65}$Zn solutions. |
| PUBLICATIONS | M.Sahagia, A.C.Razdolescu, E.L. Grigorescu, A. Luca, C.Ivan, Precise measurement of the activity of $^{186}$Re, $^{188}$Re radiopharmaceuticals, Appl.Radiat. Isot. 56 (2002) 349-356.<br>A.C.Razdolescu, M.Sahagia, A.Luca, S.Bercea, C.Dumitrescu, H.Schrader, Results obtained in the metrological certification of a commercially available radionuclide calibrator" Appl.Radiat.Isot, 56(2002), 957-958.<br>C.Campeanu, M.Sahagia, Obtaining of high activity $^{186}$Re, $^{188}$Re perrhenates to be used for biomoleculary labeling, Jour.Radioanalytical and Nucl.Chem 252 (2002)601-604<br>M.Sahagia, A.C.Razdolescu, C.Campeanu, E.L.Grigorescu, A.Luca, C.Ivan, Preparation and standardization of a $^{153}SmCl_3$ radiopharmaceutical solution" Proceeding of the international HIPAN02 Conference, Neptun, Romania 2-6.09.2002, EU, IDRANAP Excellence Centre, WP7 "Radionuclide Metrology", in press. |
| IN PROGRESS | Participation in $^{65}$Zn and $^{192}$Ir key comparison. |
| ADDRESS | IFIN-HH, str. Atomistilor 407, Com Magurele, jud. Ilfov, POB MG-6,<br>76900, Romania, tel (4021) 404 23 50,<br>fax : (4021) 457 44 32/ 457 44 40<br>e-mail: msahagia@yahoo.com; msahagia@ifin.nipne.ro |
| CONTACT: | Maria Sahagia |

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| LABORATORY | IFIN-HH, Radionuclide Metrology Laboratory |
| NAME | A.C.Razdolescu, Ph.Cassette, E.L.Grigorescu |
| APPARATUS | TDCR equipment |
| RESULTS | TDCR standardization of $^{32}$P, $^{204}$Tl and $^{68}$(Ge+Ga). |
| IN PROGRESS | TDCR standardization of $^{54}$Mn, $^{137}$Cs, $^{241}$Am. |
| ADDRESS | IFIN-HH, str. Atomistilor 407, Com Magurele, jud. Ilfov, POB MG-6,<br>76900, Romania, tel (4021) 404 23 50,<br>fax : (4021) 457 44 32/ 457 44 40<br>e-mail: razdo@yahoo.com; crazdo@ifin.nipne.com |
| CONTACT | A.C.Razdolescu |

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| LABORATORY | Radionuclide Data Centre, V.G.Khlopin Radium Institute |
| NAMES | V.P.Chechev, N.K.Kuzmenko, K.P.Iakovlev, G.E.Shchukin |
| ACTIVITY | Decay data evaluations for applied radionuclides (within the framework of CRP and DDEP activity).<br>Measurements of soft photon emission probabilities in decays of $^{237}$Np/$^{233}$Pa (in cooperation with LNHB, within the framework of EUROMET – 416). |
| RESULTS | Evaluations and recommendations of full decay-scheme data have been completed for the following 12 radionuclides: $^{99}$Mo and $^{99m}$Tc (in cooperation with LNHB), $^{57}$Co, $^{67}$Ga, $^{93m}$Nb, $^{111}$In, $^{129}$I, $^{133}$Ba, $^{154}$Eu, $^{155}$Eu, $^{170}$Tm and $^{241}$Am.<br>Emission probabilities of the main γ-, KX-and LX-rays in decays of $^{237}$Np/$^{233}$Pa have been determined with a relative uncertainty of about 2%. |
| PUBLICATIONS | Recommended data by the Decay Data Evaluation Project working group: http://www.bnm.fr/bnm-lnhb/NucData.htm<br>A.Luca, S.Sepman, K.Iakovlev, G.Shchukin, M.Etcheverry, J.Morel, Emission Probabilities of the KX-Rays following the Decay of 237Np in Equilibrium with 233Pa, Appl.Radiat.Isot. 56(2002)173. |
| OTHER RELATED PUBLICATIONS | V.P. Chechev, J. of Nucl. Sci. Techn., 2002, Suppl. 2, vol.1, p. 459-462. |
| ADDRESS | V.G.Khlopin Radium Institute, 28 Second Murinsky Ave., 194021 St.Petersburg, RUSSIA.<br>Tel.:7(812)2473706<br>Fax:7(812)2478095<br>E-mail: chechev@atom.nw.ru |
| CONTACT | V.P.Chechev |

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| LABORATORY: | D.I.Mendeleyev Institute for Metrology (VNIIM) |
| NAMES: | T.E.Sazonova, A.V.Zanevsky, S.V.Sepman, M.A.Rasko, E.E.Terechtchenko, I.A.Sokolova, A.E.Kochin, I.A.Kharitonov, N.I.Karmalitsyn |
| APPARATUS: | 1. $4\pi\beta$(PC)-$\gamma$(NaI(Tl)) and KX(0.1mm NaI(Tl))-$\gamma$(NaI(Tl))-coincidence counting systems;<br>2. $4\pi\beta$(PC)-counting system.<br>3. Calibrated gamma- and X-ray spectrometers; |
| RESULTS: | 1. Participation in the CCRI(II) key comparisons of activity measurements of $^{204}$Tl, $^{65}$Zn.<br>2. Standardization and determination of the $\gamma$-ray emission probabilities for $^{154}$Eu and $^{226}$Ra carried out with the BNM-LNHB (France). |
| ADDRESS | VNIIM, 19 Moskovsky pr., St.Petersburg 198005, Russia<br>Phone: (812) 323-96-12<br>Fax: (812) 113-01-14<br>E-mail: info2101@vniim.ru |
| CONTACT: | T.E.Sazonova |

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| LABORATORY: | D.I. Mendeleyev Institute for Metrology (VNIIM) |
| NAMES: | I.A. Kharitonov, M.A. Rasko, E.E. Terechtchenko |
| APPARATUS: | Calibrated Si(Li) spectrometers.<br>High pressurized PC (2 atm) with a variable solid angle. |
| ACTIVITY: | Standardization of point reference sources. |
| RESULTS: | Measurements of the KX and LX – ray fluxes from the point reference sources in the range 3-26 keV. |
| IN PROGRESS: | Measurements of the flux of KX – ray from the point sources $^{44}$Ti. |
| ADDRESS: | VNIIM, 19 Moskovsky pr., St. Petersburg 198005, Russia<br>Phone: (812) 323-96-12<br>Fax: (812) 113-01-14<br>E-mail: info2101@vniim.ru |
| CONTACT: | M.A. Rasko |

LABORATORY: D.I. Mendeleyev Institute for Metrology (VNIIM)

NAMES: I.A. Kharitonov, M.A. Rasko, E.E. Terechtchenko
N.D. Villevalde A.V. Oborin

APPARATUS: calibrated HPGe planar spectrometers

ACTIVITY: Standardization of industrial and medical reference sources. Restoration of real photon spectrum of x-ray radiation in a range 10-350 кэВ from apparatus spectrum with a method of response function.

RESULTS:

3. Measurement of KX and LX – ray fluxes in the range 10-350 keV from medical reference sources.
4. Restoration of a real photon spectrum of bremsstrahlung radiation from medical β-emitting radionuclides ($^{147}$Pm, $^{204}$Tl) sources in a range 10-350 keV, from the apparatus spectrum using the method of a response function.
5. Definition of the coefficient of dependence between the photon flux of KX-ray, activity and air kerma radionuclides of medical KX-ray sources on the basis radionuclides: $^{147}$Pm, $^{204}$Tl, $^{153}$Gd, $^{238}$Pu, $^{241}$Am etc.
6. Restoration of a real photon spectrum of devices from the primary national standard of air kerma GET 8-82 in a range 10-350 keV. Definition of a half-value layer and mean photon energy.

IN PROGRESS:

1. Development of Monte Carlo code for calculation of semiconductor detectors.
2. Using HPGe detector with a larger volume.

ADDRESS: VNIIM, 19 Moskovsky pr., St. Petersburg 198005, Russia
Phone: (812) 323-96-12
Fax: (812) 113-01-14
E-mail: info2101@vniim.ru

CONTACT: E.E. Terechtchenko

LABORATORY: D.I. Mendeleyev Institute for Metrology (VNIIM)

NAMES: I.A. Kharitonov, M.A. Rasko, E.E. Terechtchenko

APPARATUS: System of calibrated HPGe and Ge(Li) spectrometers.

ACTIVITY: Standardization of point, surface and volume reference sources.

RESULTS:

7. Routine standardization of 25 radionuclides in point, volume and surface sources.
8. Environmental samples measurement.
9. Measurements of photon flux of $^{235}U$ standard sources of tube and sphere geometry. Calculation of virtual mass $^{235}U$ in the range 10-1000 g with the formula

$$m = \left( \frac{I_\gamma}{I_0} \right)^{1.46}$$

where:
Iγ - photon flux of $^{235}U$ standard sources with m weight,
Io – photon flux of $^{235}U$ standard sources with 1g weight.

IN PROGRESS:

1. Development of a secondary standard of activity on the basis of semiconductor detectors
2. Activity measurements of $^{226}Ra$ primary standard mass.
3. Definition of factors of cascade summation correction for semi-conductor detectors of a great volume.

PUBLICATIONS: I.A. Kharitonov, M.A. Rasko, E.E. Terechtchenko, N.N. Moiseev "Metrological characteristics of uranium-235 and californium-252 standard sources for classification of special nuclear material monitors"
3 Annual international conference "ATOMTRANS-2000"
October 2000, St. Petersburg, Russia

ADDRESS: VNIIM, 19 Moskovsky pr., St. Petersburg 198005, Russia
Phone: (812) 323-96-12
Fax: (812) 113-01-14
E-mail: info2101@vniim.ru

CONTACT: M.A. Rasko

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| LABORATORY: | D.I. Mendeleyev Institute for Metrology (VNIIM) |
| NAMES: | A.E. Kochin, M.A. Rasko, I.A. Kharitonov, N.I. Karmalitsyn |
| APPARATUS: | Large area windowless gas flow proportional 2πβ-counter |
| RESULTS: | Participation in the intercomparisons of β-emitting rate of $^{36}$Cl large area source with NIST, INER, KRISS, PTB, CSIR and NMIJ/AIST. |
| ADDRESS | VNIIM, 19 Moskovsky pr., St. Petersburg<br>198005, Russia<br>Phone: (812) 323-96-11<br>Fax: (812) 323-96-17<br>E-mail: info2101@vniim.ru |
| CONTACT: | I.A. Kharitonov |

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|---|---|
| LABORATORY: | D.I. Mendeleyev Institute for Metrology (VNIIM) |
| NAMES: | A.E. Kochin, M.A. Rasko, I.A. Kharitonov |
| APPARATUS: | Low background Ge(Li) and 4 $\pi\gamma$ NaI sandwich type detectors, proportional gas $4\pi\beta$-counter |
| RESULTS: | Participation in the project 236/BY/01 COOMET: "Interlaboratory comparisons of colza standard reference material of the $Cs^{137}$ specific activity" |
| ADDRESS | VNIIM, 19 Moskovsky pr., St. Petersburg, 198005, Russia<br>Phone: (812) 323-96-11<br>Fax: (812) 323-96-17<br>E-mail: info2101@vniim.ru |
| CONTACT: | M.A. Rasko |

LABORATORY: D.I. Mendeleyev Institute for Metrology (VNIIM)

NAMES: I.A. Kharitonov, M.A. Rasko, E.E. Terechtchenko
A.V. Zanevsky, G.N. Semyonov, S.S. Kozlovsky*

APPARATUS: 4πγ NaI detector of the sandwich type
(two crystals 100*50 mm each, entrance window-1 mm Al).

ACTIVITY: Standardization of radioactive solutions and sources.
Nuclear data analysis.
Improvement of measurement techniques.
Preparation of sources.
Theoretical calculation of the counting efficiency for
4πγ NaI detector of the sandwich type by VC3D Monte-Carlo Code
(developer – S.S. Kozlovsky, St. Petersburg Politechnical Institute).

RESULTS:
10. Theoretical calculation of the counting efficiency for 4πγ NaI detector by VC3D for cascade radionuclides: $^{166}$Ho, $^{152}$Eu, $^{154}$Eu, $^{134}$Cs, $^{133}$Ba etc.
11. Routine standardization of point sources for 25 radionuclides.
12. Measurement of $^{198}$Au activity in gold foil for primary national standard of neutron flux.
13. Measurement of $^{134}$Cs activity solution with 4πγ NaI well crystal at LNHB (E.E. Terechtchenko).

IN PROGRESS:
4. Designing a new large 4πγ NaI detector of the sandwich type (two crystals 200*100 mm, entrance window-0.5 mm Al)
5. Development of the VC3D Monte-Carlo Code.
6. Using PENELOPE Monte-Carlo code for theoretical calculation of the counting efficiency of the 4πγ NaI detector.

ADDRESS: VNIIM, 19 Moskovsky pr., St. Petersburg 198005, Russia
Phone: (812) 323-96-12
Fax: (812) 113-01-14
E-mail: info2101@vniim.ru

CONTACT: E.E. Terechtchenko

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|---|---|
| LABORATORY | Jožef Stefan Institute, Laboratory for Radiological Measuring Systems and Radioactivity Measurements, High Resolution Gamma-Ray Spectrometry Group |
| NAMES | M. Korun, D. Glavič-Cindro, T. Vidmar, B. Vodenik |
| APPARATUS | Calibrated gamma-ray spectrometers, calibrating facility for gamma-ray detectors |
| PUBLICATIONS | D. Glavič-Cindro, M. Korun, M. Korun, Analysis of nonconforming work as a tool for status analysis and continuous improvement, Accredit. Qual. Assur. 7 (2002) 66.<br><br>M. Korun, Propagation of the uncertainties of sample position to the uncertainty of the counting efficiency in gamma-ray spectrometry, Appl. Radiat. Isot. 57 (2002) 415.<br><br>D. Glavič-Cindro, M. Korun, B. Vodenik, Traceability of measurement results of the effective acquisition time in the gamma-ray spectrometry implemented by the pulser method, Accred. Qual. Assur. 7 (2002) 529.<br><br>A. Likar, T. Vidmar, Analysis of gamma-ray spectra from HPGe detectors in field conditions without explicit energy calibration, Appl. Radiat. Isot. 57 (2002) 67.<br><br>A. Likar, T. Vidmar, M. Lipoglavšek, G. Omahen, Monte Carlo calculations of the entire in-situ gamma-ray spectra, Proceedings of the International Symposium on In-situ Nuclear Metrology as a Tool for Radioecology, Fleurus, Belgium, 10-12 June 2002. |
| IN PROGRESS | Measurement of the average paths lengths of gamma-rays in Marinelli beakers, calculation of coincidence summing effects for infinite samples, modelling of peak and total efficiencies, measurement of the peak and total efficiencies for point sources with gamma-ray emitters exhibiting cascade decays. |
| SOURCE IN PREPARATION | A. Likar, T. Vidmar, Optimal functions for peak search methods based on spectrum convolution, submitted to Acta Physica Slovaca. |

A. Likar, T. Vidmar, A peak search method based on spectrum convolution, submitted to Nucl. Instr. and Meth. A.T. Vidmar, M. Korun, A. Likar, Close-geometry calib in gamma-ray spectrometry using radio-nuclides with a two-ste cascade, submitted to Nucl. Instr. and Meth. A.

M. Korun, T. Vidmar, Calculation of self-attenuation factors for well-type geometry, submitted to Czechoslovak Journal of Physics.

ADDRESS "Jožef Stefan" Institute
Jamova 39
1000 Ljubljana, Slovenia

Telephone: +386 1 477 39 00
Fax: +386 1 423 21 20
Telex: 31 296 JOSTIN SI

CONTACT M. Korun, e-mail: matjaz.korun@ijs.si

(SA1/SA2)

LABORATORY CSIR-National Metrology Laboratory

NAMES Bruce Simpson, Freda Morris

**Activities undertaken in 2002**

- Trained a member of the Australian Nuclear Science and Technology Organisation (ANSTO) on direct liquid scintillation counting techniques for the standardization of radionuclides.
- Submitted a standardised solution of $^{60}$Co to the SIR of the BIPM.
- Participated in the BIPM international comparison of $^{204}$Tl, utilising the triple-to-double coincidence ratio (TDCR) efficiency calculation technique and the $4\pi(X,e)$-$X_K$ extrapolation method.
- Developed a procedure to produce solid water-equivalent volume sources based on a superabsorbent polymer.
- Measured the activity concentration of a $^{33}$P solution by two liquid scintillation methods.
- Standardised a solution of $^{22}$Na and provided weak $^{22}$Na sources sealed in special plastic scintillator disk holders.

**Programme for 2003**

- Participate in the full-scale international comparisons of activity measurement of $^{65}$Zn, $^{192}$Ir and $^{241}$Am being organised by the BIPM.
- Prepare papers and posters that have been accepted for presentation at the ICRM 2003 conference being held in Dublin.
- Complete all quality related documentation in readiness for an end-of-year ISO 17025 audit for laboratory accreditation purposes.
- Design and assemble a symmetrical three phototube LS detection system for activity measurement of non-γ-emitting radionuclides.
- Provide radioactivity standards and sources to the user community.

PUBLICATIONS B.R.S. Simpson, *Radioactivity Standardization in South Africa.* Appl. Radiat. Isot. 56 (2002) 301-305.

ADDRESS Radioactivity Standards Laboratory, CSIR-NML
15 Lower Hope Road, Rosebank 7700
Cape Town, SOUTH AFRICA
Tel./fax (office) 27 21 686 2759, Tel. (lab) 27 21 685 4325
Fax (reception) 27 21 686 6116
E-mail : bsimpson@csir.co.za

CONTACT B.R.S. Simpson

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| LABORATORY | Metrología de Radiaciones Ionizantes, CIEMAT |
| NAMES | Teresa Crespo |
| APPARATUS | Grid □onisation chambers, alpha spectrometers with semiconductor detectors. |
| ACTIVITY | Standardization of alpha-emitting nuclides.U-series disequilibrium: applications to environmental and geological studies. |
| PUBLICATIONS | Sequential leaching methods: review, previous experiences and proposed method for Fe(III)-U(VI)-rich fracture filling materials. L. Pérez del Villar, A.J. Quejido, M.T. Crespo, M. Sánchez, J.S. Cózar, M.P. Galán, M. Fernández-Díaz. Trends in Geochemistry (in press).<br>Standardization and decay data of $^{237}$Np. M.J. Woods, D.H. Woods, S.A. Woods, L.J. Husband, S.M. Jerome, C. Michotte, G. Ratel, M.T. Crespo, E.García-Toraño, L.Rodriguez, A. Luca, B.Denecke, G. Sibbens, J. Morel, M. Etcheverry, D. Santry, H. Janssen, E. Schönfeld, U. Schötzig. Appl. Radiat. Isot. 56 (2002) 415-420.<br>U-series in Fe-U-rich fracture fillings from the oxidised cap of the "Mina Fe" uranium deposit (Spain): implications for proceses in a radwaste repository. M.T. Crespo, L. Pérez del Villar, A.J. Quejido, M. Sánchez, J.S. Cózar, M. Fernández-Díaz. Applied Geochemistry (in press). |
| IN PROGRESS | U/Th dating of carbonates for archaeological and paleoclimate applications. |
| ADDRESS | Metrología de radiaciones, Dpto. de Fusión y Partículas Elementales.<br>CIEMAT<br>Ed. 3, Avda. Complutense 22<br>28040 Madrid, Spain.<br>Fax: 34 913466121<br>Email: teresa.crespo@ciemat.es |
| CONTACT | Teresa Crespo |

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|---|---|
| LABORATORY | Metrología de Radiaciones Ionizantes, CIEMAT |
| NAMES | Miguel Roteta, Eduardo García-Toraño,<br>Leonor Rodríguez Barquero, |
| APPARATUS | Solid state detectors; 4πβ(pc)-γ(NaI) coincidence counter; 4πβ(ppc)-γ(NaI) coincidence counter; large volume proportional counter; liquid scintillation counters. |
| ACTIVITY | Preparation of reference solutions used for intercomparisons of analytical laboratories from nuclear power plants.<br>Participation in the BIPM key comparisons of activity measurements of $^{32}$Pu and $^{204}$Tl<br>Standardization of $^{99m}$Tc, $^{67}$Ga and $^{131}$I by 4πβ-γ coincidence counting and gamma spectrometry.<br>Contribution to the S.I.R. program of the BIPM with an ampoule of $^{131}$I.<br>Standardization of radionuclides ($^{60}$Co, $^{32}$P/$^{33}$P, $^{204}$Tl) by Liquid Scintillation counting. |
| PUBLICATIONS | E.García-Toraño, L.Rodríguez Barquero and M.Roteta, "Standardization of $^{134}$Cs by three methods ", Appl. Radiat. Isot. 56 (2002)211-214.<br>M.J.Woods et al.,"Standardization and decay data of $^{237}$Np", Appl. Radiat. Isot. 56 (2002)415-420. |
| IN PROGRESS | Standardization of $^{67}$Ga by 4πβ(ppc)-γ(NaI) coincidence counting and 4πγ for contribution to S.I.R.<br>Standardization of $^{109}$Cd by Liquid Scintillation Counting<br>Standardization of reference solutions of beta and gamma-emitting radionuclides for environmental intercomparison programs. |
| ADDRESS | Metrología de Radiaciones, Dpto. Fusión y Partículas Elementales, CIEMAT, Ed. 12, Avda. Complutense 22, 28040 Madrid, Spain.<br>FAX : 34 9 346 6442<br>E. García-Toraño : Phone 34 91 346 6225<br>E.Garciatorano@ciemat.es<br>M. Roteta : Phone 34 91 346 6244<br>Miguel.Roteta@ciemat.es<br>L. Rodríguez Barquero Phone 34 91 346 6566<br>L.Barquero@ciemat.es |
| CONTACT | Eduardo García-Toraño |

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|---|---|
| LABORATORY | Metrología de Radiaciones Ionizantes, CIEMAT |
| NAMES | Eduardo García-Toraño, María Teresa Crespo |
| APPARATUS | High resolution alpha spectrometry system, Ionization chambers, low solid angle detector. |
| ACTIVITY | $\alpha$-particle emission probability ($P_\alpha$) measurements.<br>Coordination of the "Alpha-Particle Spectrometry Working Group" of the ICRM.<br>Development of new programs for spectral analysis.<br>Participation in the IAEA Coordinated Research Programme "Development and application of Alpha Particle Spectrometry".<br>Participation in the EUROMET 591 project, (Alpha-particle emission probabilities of $^{235}U$). |
| IN PROGRESS | Measurement of the alpha-particle emission probabilities of $^{235}U$ (EURATOM 591)<br>Development of a simple line shape model to be used in a new fitting program in the frame of the IAEA CRP on Alpha Spectrometry. (to be published in NIM A,in press) |
| ADDRESS | Metrología de Radiaciones, Dpto. Fusión y Partículas Elementales, CIEMAT, Ed. 12, Avda. Complutense 22, 28040 Madrid, Spain.<br>FAX : 34 91346 6442<br><br>E. García-Toraño : Phone 34 91346 6225<br>E.Garciatorano@ciemat.es<br>M.T. Crespo : Phone 34 91346 6553<br>Teresa.Crespo@ciemat.es |

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| LABORATORY | Metrología de Radiaciones Ionizantes, CIEMAT |
| NAMES | Eduardo García-Toraño, José María Los Arcos, Miguel Roteta and Leonor Rodríguez Barquero |
| APPARATUS | Ionization chambers, coincidence counters, activimeters, Liquid Scintillation Counters, semiconductor detectors. |
| ACTIVITY | Nuclear Medicine Programme.<br>Evaluation of the traceability of nuclear medicine services in the Community of Madrid. Standardization of solutions and analysis of results. |
| PUBLICATIONS | E. García-Toraño, L. Rodríguez Barquero and M.Roteta,"Resultados de la I campaña de evaluación de la trazabilidad de activímetros de los servicios de medicina nuclear en la comunidad autónoma de Madrid", Ciemat Technical Report nº 987, Madrid, 2002. |
| IN PROGRESS | Development of a Protocol for the Calibration of Activimeters. |
| ADDRESS | Metrología de Radiaciones, Dpto. Fusión y Partículas Elementales, CIEMAT, Ed. 12, Avda. Complutense 22, 28040 Madrid, Spain.<br>FAX : 34 91346 6442<br><br>E. García-Toraño : Phone 34 91346 6225<br>E.Garciatorano@ciemat.es<br><br>J.M. Los Arcos : Phone 34 91346 6288<br>Jm.Losarcos@ciemat.es<br><br>M. Roteta : Phone 34 91 346 6244<br>Miguel.Roteta@ciemat.es |
| CONTACT | Eduardo García-Toraño |

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|---|---|
| LABORATORY | Metrología de Radiaciones Ionizantes, CIEMAT |
| NAMES | José María Los Arcos and Leonor Rodríguez Barquero |
| APPARATUS | Liquid Scintillation Counters. |
| IN PROGRESS | Development of a reference scintillator coktail.<br>Determination of KB parameter in Scintillators.<br>Absolute Liquid Scintillation Spectral Efficiency |
| ADDRESS | Metrología de Radiaciones, Dpto. Fusión y Partículas Elementales, CIEMAT, Ed. 12, Avda. Complutense 22, 28040 Madrid, Spain.<br>FAX : 34 91346 6442<br><br>J.M. Los Arcos : Phone 34 91346 6288<br>Jm.Losarcos@ciemat.es<br>L.Rodríguez Barquero :Phone 34 91 346 6566<br>L.Barquero@ciemat.es |
| CONTACT | J.M. Los Arcos |

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| LABORATORY | Departamento de Física. Universidad de Extremadura. |
| NAMES | A.M. Carrasco Lourtau, A. Fernández Timón, M. Galán López, V. Gómez Escobar, M. Jurado Vargas, A. Martín Sánchez, M.P. Rubio Montero. |
| APPARATUS | Alpha spectrometers with PIPS detectors.<br>Liquid scintillation spectrometer.<br>HpGe and Ina(Tl) detectors. |
| ACTIVITY | Alpha, beta and gamma spectrometry. Alpha, beta and gamma measurements in environmental samples. |
| RESULTS | Studies of Ra, Rn, Th, U, and Pu activities in environmental samples. Programs for analysis of alpha spectra. Nuclear data for alpha emitting nuclides. Montecarlo simulations in alpha and gamma spectrometry |
| PUBLICATIONS | - A. Martín Sánchez, M.J. Nuevo Sánchez, M.P. Rubio Montero, A. Méndez Vilas. *Study of inhomogeneities in sources prepared for ∀-particle spectrometry using scanning probe microscopy.*Appl. Radiat. Isot. **56**, 31-36 (2002).<br>- A. Martín Sánchez, A. Fernández Timón, M.P. Rubio Montero. *The effect of energy losses in ∀-particle sources on the shape of peaks in spectra obtained with wide-angle geometry*. Appl. Radiat. Isot. **56**, 51-55 (2002).<br>- M. Jurado Vargas, A. Fernández Timón, N. Cornejo Díaz, D. Pérez Sánchez. *Monte-Carlo simulation of the self-absorption corrections for natural samples in gamma-ray spectrometry.* Appl. Radiat. Isot. **57**, 893-898 (2002).<br>- M. Jurado Vargas, A. Fernández Timón, N. Cornejo Díaz, D. Pérez Sánchez. *Influence of the geometrical characteristics of an HpGe detector on its efficiency.* J. Radioanal. Nucl. Chem. **253**, 439-443 (2002).<br>- A. Martín Sánchez, M.J. Nuevo, M. Jurado Vargas, J. Díaz Bejarano, M.F. da Silva, C. Roldán García, A. Paúl, J.L. Ferrero Calabuig, A. Méndez Vilas, D. Juanes Barber. *Application of atomic and nuclear techniques to the study of inhomogeneities in electrodeposited ∀-particle sources*. Nucl. Instrum. Method Phys. Res. B **190**, 747-50 (2002).<br>- F. Vera Tomé, V. Gómez Escobar, A. Martín Sánchez. *Study of the peak shape in alpha spectra measured by liquid scintillation*. Nucl. Instrum. Methods Phys. Res. A **485**, 444-52 (2002). |

- A. Méndez Vilas, M.J. Nuevo, and A. Martín Sánchez. *Scanning probe analysis of the ultrastructure of electrodeposited layers of uranium*. Phys. Low-Dim. Struct. **5/6**, 163-70 (2002).

IN PROGRESS

Studies about interactions of alpha particles. Methods for measuring alpha and beta emitting nuclides. Computer simulations of radiation-matter interactions. Studies about efficiency in gamma semiconductor detectors

IN PREPARATION

- D. Pérez Sánchez, A. Martín Sánchez, M.R. García Sanz, A. Fernández Timón. *Radioanalytical method for the determination of $^{90}Sr$ in soil samples by Yttrium solvent extraction and Cerenkov counting.* Royal Society of Chemistry (in press).
- D. Pérez Sánchez, A. Martín Sánchez, M. Jurado Vargas. *$^{210}Pb$ and $^{210}Po$ determination in environmental samples using liquid scintillation counting and alpha spectrometry.* Czechoslovak Journal of Physics (accepted for publication).

ADDRESS

Departamento de Física
Universidad de Extremadura
06071 Badajoz, Spain
Phone (+34)-924 28 95 26
Fax (+34)-924 28 96 51
E-mail: ams@unex.es

CONTACT

Alejandro Martín Sánchez

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|---|---|
| LABORATORY | IRA-METAS<br>Institut universitaire de radiophysique appliquée<br>Grand-Pré 1<br>CH-1007 Lausanne<br>Switzerland |
| NAMES | François Bochud<br>Philippe Spring<br>Youssef Nedjadi<br>Jean-Pascal Laedermann |
| APPARATUS ACTIVITY | Renewal of 4πPC (X, e) -γ acquisition system through a LabView program.<br>Development of a primary apparatus for Rn-222 activity measurement (following Picolo method).<br>Monte Carlo simulation of IG11 and commercial well-type ionisation chambers. |
| RESULTS | Participation in international comparisons:<br>• Tl-204. Measurement by liquid scintillation and CIEMAT-NIST method with a standard uncertainty of 0.4%.<br>• P-32. Measurement by liquid scintillation and CIEMAT-NIST method with a standard uncertainty of 0.5%.<br>• Zn-65. Measurement by 4πPC (X, e) -γ with a relative standard uncertainty of 0.4%.<br>Preparation of three Co-57 liquid reference sources for nuclear medicine activimeters calibration.<br>Preparation of 300 Pu-242 tracer-sources for activity surveillance of the environment. |
| IN PROGRESS | Refinement of the Rn-222 activity measurement primary method.<br>Monte Carlo calculations of IG11 and commercial well-type ionisation chambers.<br>Monte Carlo calculations of a HPGe well-type detector. |

ADDRESS

- François Bochud
  Institut universitaire de radiophysique appliquée
  Grand Pré 1
  CH-1007 Lausanne
  francois.bochud@inst.hospvd.ch.
  Tel: +41-21-623-3450
  Fax: +41-21-623-3435
- Philippe Spring
  Institut universitaire de radiophysique appliquée
  Grand Pré 1
  CH-1007 Lausanne
  philippe.spring@chuv.hospvd.ch.
  Tel: +41-21-693-3665
  Fax: +41-21-623-3435
- Youssef Nedjadi
  Institut universitaire de radiophysique appliquée
  Grand Pré 1
  CH-1007 Lausanne
  youssef.nedjadi@hospvd.ch.
  Tel: +41-21-693-5576
  Fax: +41-21-623-3435
- Jean-Pascal Laedermann
  Institut universitaire de radiophysique appliquée
  Grand Pré 1
  CH-1007 Lausanne
  jean-pascal.laedermann@inst.hospvd.ch.
  Tel: +41-21-623-3455
  Fax: +41-21-623-3435

CONTACT François Bochud

(SA1/SA2)

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| LABORATORY | NMi Van Swinden Laboratorium |
| NAMES | W. de Vries |
| APPARATUS | 1. Ionisation chamber, with Keithley 617-based charge measuring system, built into a lead castle<br>2. HPGe-detector with standard electronics, built into a lead castle<br>3. Windowless large area flow proportional counter, built into a lead castle<br>4. LSC measurement system for primary standard |
| IN PROGRESS | 1. Ongoing calibration of the HPGe-detector for ampoules<br>2. Beta-measurement system for a coincidence standard |
| ADDRESS | NMi Van Swinden Laboratorium<br>Dept. Radiation and Length<br>PO Box 80 000<br>3508 TA UTRECHT, The Netherlands<br>Tel.: +31 30 253 90 98, Fax.: +31 30 253 90 95<br>E-mail: WdeVries@NMi.nl |
| CONTACT | W. de Vries |

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|---|---|
| LABORATORY | National Physical Laboratory |
| NAMES | Denise Woods, Lena Johansson, Andy Pearce, Dagmara Tyler, Arzu Arinc, Andy Stroak |
| APPARATUS | 4πβ-γ coincidence counting systems (atmospheric and high pressure)<br>Liquid scintillation – gamma coincidence counting systems |
| RESULTS | Standardisation of radionuclides for medical applications by tracer technique (Y-90, Sr-89)<br>Standardisation of Tl-204 (BIPM) |
| IN PROGRESS | Standardisation of Zn-65 & Ir-192 (BIPM)<br>Development of Monte Carlo model of coincidence counting<br>Improvements in source preparation techniques (use of seeding agents) |
| ADDRESS | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington<br>Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 20 8943 8600<br>Fax: +44 20 8943 8700<br>E-mail: radioactivity@npl.co.uk |
| CONTACT | Lena Johansson, Denise Woods |

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| LABORATORY | National Physical Laboratory |
| NAMES | Nigel Watkins, John Keightley (on secondment to IRMM) |
| ACTIVITY | Development of digital pulse processing techniques for coincidence counting |
| RESULTS | Digital Coincidence Counting software validated for use with computer discrimination method (using, eg, high pressure proportional counter or liquid scintillation counter). Results from method compared to results from conventional analogue counting system for selected radionuclides– excellent agreement was found. |
| IN PROGRESS | Extension to use with atmospheric pressure proportional counters. |
| ADDRESS | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington<br>Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 20 8943 8600<br>Fax: +44 20 8943 8700<br>E-mail: radioactivity@npl.co.uk |
| CONTACT | Nigel Watkins |

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| LABORATORY | National Physical Laboratory |
| NAMES | Desmond MacMahon, Julian Dean, Andrea Woodman, Hilary Phillips |
| APPARATUS | Internal proportional gas counting systems |
| RESULTS | Capability for standardisation of 3H, 85Kr and 133Xe has been maintained.<br>Calibration service for tritium in air and tritiated water monitors maintained |
| ADDRESS | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington<br>Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 20 8943 8600<br>Fax: +44 20 8943 8700<br>E-mail: radioactivity@npl.co.uk |
| CONTACT | Julian Dean |

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| LABORATORY | National Physical Laboratory |
| NAMES | Nigel Watkins, Andy Pearce, Sean Collins, Arzu Arinc |
| APPARATUS | High resolution gamma-ray spectrometry systems<br>Environmental level gamma-ray spectrometry systems |
| IN PROGRESS | Installation of new software / hardware for data collection and analysis.<br>Testing of Minimum Detectable Activity algorithms |
| ADDRESS | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington<br>Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 20 8943 8600<br>Fax: +44 20 8943 8700<br>E-mail: radioactivity@npl.co.uk |
| CONTACT | Nigel Watkins |

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| LABORATORY | National Physical Laboratory |
| NAMES | Arvic Harms, Dagmara Tyler, Chris Gilligan, Simon Jerome |
| ACTIVITY | Standards for environmental monitoring |
| RESULTS | Continued production of low level solution standards<br>Participation in NIST seaweed project |
| IN PROGRESS | Development of standards for organically bound tritium<br>Development of depleted uranium reference material |
| ADDRESS | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington<br>Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 20 8943 8600<br>Fax: +44 20 8943 8700<br>E-mail: radioactivity@npl.co.uk |
| CONTACT | Arvic Harms |

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| LABORATORY | National Physical Laboratory |
| NAMES | Lena Johansson, Andy Pearce, Andrea Woodman, Andy Stroak |
| APPARATUS | Liquid scintillation counting methods |
| RESULTS | Software for NIST-CIEMAT method for electron capture radionuclides installed and validated using xxxx.<br>Digital coincidence counting installed on liquid scintillation counter |
| IN PROGRESS | Validation of TDCR method |
| ADDRESS | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington<br>Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 20 8943 8600<br>Fax: +44 20 8943 8700<br>E-mail: radioactivity@npl.co.uk |
| CONTACT | Andy Pearce |

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| LABORATORY | National Physical Laboratory |
| NAMES | Michaela Baker, Kalyani Chari, Simon Jerome, Andy Pearce, Nigel Watkins, Dagmara Tyler |
| APPARATUS | Re-entrant ionisation chambers |
| RESULTS | Study of correction factors for syringes / Schott vials measured on commercial ionisation chambers<br>International comparison of F-18 measurements |
| IN PROGRESS | Study of use of copper insert to improve measurement accuracy for I-124 measurements<br>Installation of robotic sample changer system<br>Development of new ionisation chamber for BIPM SIR system<br>Modelling of BIPM SIR chamber |
| ADDRESS | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington<br>Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 20 8943 8600<br>Fax: +44 20 8943 8700<br>E-mail: radioactivity@npl.co.uk |
| CONTACT | Michaela Baker |

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| LABORATORY | National Physical Laboratory |
| NAMES | Julian Dean |
| APPARATUS | Radon in air and radon in water dispensing systems |
| RESULTS | Standardisation of radionuclides for medical applications by tracer technique (Y-90, Sr-89)<br>Standardisation of Tl-204 (BIPM) |
| IN PROGRESS | Re-installation and validation following relocation to new facility |
| ADDRESS | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington<br>Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 20 8943 8600<br>Fax: +44 20 8943 8700<br>E-mail: radioactivity@npl.co.uk |
| CONTACT | Julian Dean |

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| LABORATORY | National Physical Laboratory |
| NAMES | Clare Scott, Hilary Phillips |
| APPARATUS | Windowless large area proportional counter |
| RESULTS | Continued provision of service for determining emission rate from large area reference sources |
| IN PROGRESS | Upgrading of pressure control system and installation of second counter |
| ADDRESS | Centre for Acoustics and Ionising Radiation<br>National Physical Laboratory<br>Teddington<br>Middlesex<br>United Kingdom<br>TW11 0LW<br>Tel: +44 20 8943 8600<br>Fax: +44 20 8943 8700<br>E-mail: radioactivity@npl.co.uk |
| CONTACT | Clare Scott |

LABORATORY Idaho National Engineering and Environmental Laboratory

NAME R. G. Helmer

ACTIVITY This is my activity report under ICRM standings actions SA1 and SA2 for the years 2002 and 2003.

Accomplishments for 2002

1. Evaluated decay data for international Decay Data Evaluation Project, in particular for the decay of $^{24}$Na, $^{110}$Ag, and $^{110m}$Ag.
2. Evaluated nuclear structure data for Evaluated Nuclear Structure Data File (ENSDF), and the associated Nuclear Data Sheets, in particular that for the A=87 nuclides has been published and that for A=159 has been submitted.
3. Evaluated decay data for 15 nuclides for inclusion in the revision of IAEA TECDOC-619.
4. Co-author with J. C. Hardy and others of papers entitled "Precise Efficiency Calibration of an HPGe Detector: Source Measurements and Monte Carlo Calculations with Sub-percent Precision" in Applied Radiation and Isotopes 56 (2002) 65 and "The Use of Monte Carlo Calculations in the Determination of a Ge Detector Efficiency Curve" submitted to Nuclear Instruments and Methods A.

Plans for 2003

1. Continue work on precise determination of Ge detector efficiencies, especially by means of Monte Carlo calculations.
2. Continue nuclear structure and decay data evaluations for ENSDF and the associated Nuclear Data Sheets for A=158 and evaluations for the Decay Data Evaluation Project.

ADDRESS Idaho National Engineering and Environmental Laboratory
P. O. Box 1625
Idaho Falls, Idaho 83415-2114 USA
Phone (208)526-4155
Fax (208)526-9267
E-mail : HelmerR@pcif.net

CONTACT R. G. Helmer

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| LABORATORY | Idaho National Engineering and Environmental Laboratory |
| NAMES | R. J. Gehrke, INEEL; P. Shebell, U. S. DOE EML; F. Bronson, Canberra Industries; S. Faller, U.S., EPA; M. Unterweger, U. S. NIST; D. Keefer, Duke Engineering & Services; R. Reiman, self employed |
| ACTIVITY | An American National Standards Institute (ANSI) "Performance Standard for the Calibration of Germanium Detectors for In-Site Gamma-Ray Measurements" (N42.28) has been approved by the ANSI. Publication is expected by summer of 2003. |
| IN PROGRESS | Revision of ANSI N42.25 to begin in spring of 2003. |
| ADDRESS | Idaho National Engineering and Environmental Laboratory<br>P. O. Box 1625<br>Idaho Falls, Idaho 83415-2114 USA<br>Phone (208) 526-4157<br>Fax (208) 526-9267<br>E-mail rjg@inel.gov |
| CONTACT | R. J. Gehrke |

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| LABORATORY | National Institute of Standards and Technology |
| NAMES | M. P. Unterweger |
| APPARATUS | 4πβ-γ Pressurized Ionization Chamber |
| ACTIVITY | Half life measurements |
| IN PROGRESS | The halflives of high purity $^{76}$As, $^{198}$Au, $^{42}$K, and $^{24}$Na are being measured. |
| ADDRESS | NIST<br>100 Bureau Dr.<br>Stop 8462<br>Gaithersburg, MD 20899-8462 USA<br>Phone: +1-301-975-5536<br>Fax: +1-301-926-7416<br>unterweg@nist.gov |
| CONTACT | M. P. Unterweger |

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| LABORATORY | National Institute of Standards and Technology |
| NAMES | L. Pibida, M. Millican, B. Zimmerman, L. Karam, J. Cessna |
| APPARATUS<br>ACTIVITY | Calibrated HPGe detectors with standard electronics and computers |
| RESULTS | Measurement of activities and impurities in numerous sample materials from nuclear power plants, for nuclear medicine and homeland security applications. Combined work with the Nuclear Energy Institute (NEI) for activity measurements of radiopharmaceuticals, source manufactures and nuclear power plants monitoring. Efficiency calibrations of semiconductor detector systems in a wide variety of geometries. |
| IN PROGRESS | Upgrade and expansion of measuring capabilities concerning available detectors and geometries. Utilization of these systems in the development and refinement of the available, as well as new, SRMs. Development of new SRMs for homeland security. |
| ADDRESS | NIST<br>100 Bureau Dr.<br>Stop 8462<br>Gaithersburg, MD 20899-8462 USA<br>Phone: +1-301-975-5538<br>Fax: +1-301-926-7416<br>leticia.pibida@nist.gov |
| CONTACT | L. Pibida |

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| LABORATORY | National Institute of Standards and Technology |
| NAMES | L. Pibida and B. A. Bushaw (PNNL) |
| APPARATUS/ ACTIVITY | At NIST a resonance ionization mass spectrometry (RIMS) system has been developed as sensitive and selective device for low-level measurements of radio-cesium in the environment. It consists of three main components: a resistively heated graphite crucible for efficient sample atomization, a laser system for selective ionization of neutral atoms in the gas phase, and a magnetic sector mass spectrometer used for analysis and final detection of the photo-ions. |
| RESULTS | Resonance ionization spectroscopy avoids isobaric interferences via selectively ionizing the element of interest by tunable laser light. This technique allows analysis of environmental samples with minimum chemical preparation. Determination of the $^{135}$Cs / $^{137}$Cs ratio is performed using single-resonance optical excitation $6s\ ^2S_{1/2}$ ($F = 4$) $\rightarrow$ $6p\ ^2P_{3/2}$ ($F' = 5$) with an external cavity high-resolution continuous-wave diode laser working at 852nm followed by photoionization with the 488 nm line of an argon ion laser. The combination of optical and mass spectrometer selectivity adds to an overall value of $10^9$ attained for $^{135}$Cs and $^{137}$Cs in the suppression of stable $^{133}$Cs. Overall detection efficiency for the RIMS process of $5\times10^{-7}$ was demonstrated. Test measurements on samples containing as much as $10^7$ excess of $^{133}$Cs were performed successfully and demonstrated detection limits of $5\times10^9$ atoms. While the activity equivalent for $^{137}$Cs is as high as ~ 400 mBq, the value for $^{135}$Cs is ~ $4\times10^{-3}$ mBq, far below the level of detection of conventional decay counting methods. Via RIMS isotope ratio measurements of $^{135}$Cs / $^{137}$Cs a precise dating of a $^{137}$Cs nuclear-fuel-burn-up sample standard reference material (SRM), whose isotopic composition had been accurately measured two decades previously, was achieved. |
| PUBLICATIONS | Evaluation of Resonance Ionization Mass Spectrometry for the Determination of $^{135}$Cs/$^{137}$Cs Isotope Ratio in Low-level Samples. L. Pibida, W. Nörtershäuser, J.M.R. Hutchinson, and B.A. Bushaw. *Radiochim. Acta* **89**, 161-168 (2001) |
| IN PROGRESS | Improvement in the efficiency, further testing and application to lake and soil sediments SRMs and analytical samples will be carried out. Subsequently measurements on environmental samples are foreseen. |

ADDRESS NIST
100 Bureau Dr.
Stop 8462
Gaithersburg, MD 20899-8462 USA
Phone: +1-301-975-5538
Fax: +1-301-926-7416
leticia.pibida@nist.gov

CONTACT L. Pibida

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| LABORATORY | National Institute of Standards and Technology |
| NAMES | B. E. Zimmerman, R. Collé, J. T. Cessna |
| APPARATUS ACTIVITY | Triple-to-Double-Coincidence Ratio (TDCR) LS Spectrometer |
| IN PROGRESS | A Triple-to-Double Coincidence Ratio liquid scintillation spectrometer, based on the systems in use at Swierk and LNHB, has been constructed at NIST. Studies are underway to assess its performance, measuring radionuclides such as $^{3}H$, $^{54}Mn$, $^{63}Ni$, $^{90}Y$, $^{90}Sr$, and $^{204}Tl$ and comparing the TDCR results either to previously standardized values or those obtained with the CIEMAT/NIST efficiency tracing method. |
| ADDRESS | NIST<br>100 Bureau Dr.<br>Stop 8462<br>Gaithersburg, MD 20899-8462 USA<br>Phone: +1-301-975-5191<br>Fax: +1-301-926-7416<br>bez@nist.gov |
| CONTACT | B. E. Zimmerman |

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| LABORATORY | National Institute of Standards and Technology |
| NAMES | B. E. Zimmerman, J. T. Cessna, M. A. Millican |
| APPARATUS ACTIVITY | Commercial re-entrant ionization chambers ("dose calibrators") |
| IN PROGRESS | Studies have been carried out to assess the effect of measurement geometry on the activity determination of solutions of $^{90}$Y in re-entrant ionization chambers using clinically relevant geometries such as syringes. Data were collected on 5 different instruments from 3 manufacturers in the standard NIST ampoule, as well as in 10 mL plastic syringes in order to either confirm, in the case of the ampoule, the previously determined calibration factors, or determine new calibration factors. In addition, the effect of filling volume on the measurement was studied, as was possible differences in measurement results between a standardized $^{90}$Y solution containing nominally 60 μg/g of $YCl_3$ in 1 mol·L$^{-1}$ HCL and a recently approved $^{90}$Y-based radioimmunotherapy drug. |
| ADDRESS | NIST<br>100 Bureau Dr.<br>Stop 8462<br>Gaithersburg, MD 20899-8462 USA<br>Phone: +1-301-975-5191<br>Fax: +1-301-926-7416<br>bez@nist.gov |
| CONTACT | B. E. Zimmerman |

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| LABORATORY | National Institute of Standards and Technology |
| NAMES | B. E. Zimmerman, R. Collé |
| ACTIVITY | Standardization of $^{103}$Pd by Liquid Scintillation (LS) Counting Using the TDCR and CIEMAT/NIST Methods |
| RESULTS | Solutions of $^{103}$Pd, prepared by dissolution of $^{103}$Pd prostate seeds, were measured for massic activity using both the new NIST TDCR system and the CIEMAT/NIST efficiency tracing method with a standardized $^{54}$Mn solution employed as the tracer. Master solutions were prepared from each of two sets of $^{103}$Pd seeds, one being a specially-prepared « high-level » seed and one normally encountered for therapeutic use, and diluted to appropriate levels for LS counting. The massic activity of the « normal » solution was found to be 1.67±0.02 MBq·g$^{-1}$ and 1.64±0.04 MBq·g$^{-1}$ for the TDCR and CIEMAT/NIST techniques, respectively. For the « high-level » solution, the massic activity results were 95.5±1.4 MBq·g$^{-1}$ and 93.7±2.2 MBq·g$^{-1}$ for the TDCR and CIEMAT/NIST methods, respectively. The above uncertainties are expanded ($k$=2) uncertainties. The largest uncertainty component for the TDCR measurements was reproducibility between prepared sources (0.48%), while the largest for the CIEMAT/NIST measurements were dependencies on the spectrometer (0.76 %) and on the commercial scintillant (0.68 %). Asymmetry in the TDCR phototube responses, as well as inconsistencies in the $^{103}$Pd decay scheme are expected to contribute significant, although not yet evaluable, systematic errors in the above results and will require further investigation. |
| ADDRESS | NIST<br>100 Bureau Dr.<br>Stop 8462<br>Gaithersburg, MD 20899-8462 USA<br>Phone: +1-301-975-5191<br>Fax: +1-301-926-7416<br>bez@nist.gov |
| CONTACT | B. E. Zimmerman |

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| LABORATORY | National Institute of Standards and Technology |
| NAMES | L.K. Selvig (NIST and Centennial High School, Boise, ID), K.A. Lee (NIST and Department of Physics, Miami University of Oxford, OH), K. Inn |
| ACTIVITY | Decomposition of U/Th Bearing Minerals and the Implication Towards Environmental Clean Up |
| IN PROGRESS | Minerals in the soils range from those that easily weathered to those, which are very resistant to the weathering processes. Many of these resistant minerals have a tendency to harbor uranium and thorium within their crystal structure. These "resistates" can contain as much as 15-20% of the total uranium and thorium present in the soil. What acid dissolution procedures can be employed to dissolve these mineral resistates? How much uranium and thorium are in resistates? Would the amount of uranium and thorium hidden in the resistates affect remediation procedures? Is there a public health threat because of the amount of uranium and thorium harbored in resistates?<br><br>To answer these questions seven resistate minerals were chosen. They were chosen based on chemical composition and commonality. Three of the minerals are classified as silicates, three are phosphates and one is an oxide. The minerals were crushed, powdered and put through an acid dissolution process. Samples were first treated with sulfuric acid followed by hydrofluoric- nitric- and perchloric. The effect of the different acids on the minerals varied with the sample. The phosphate minerals were affected most by sulfuric acid while the silicates were most affected by nitric acid and hydrofluoric acid. Uranium and thorium isotopes were isolated and their level of activity determined by alpha spectroscopy following electrodeposition. Powder x-ray diffraction patterns were analyzed before and after the acid treatment to determine the effects of the acids on the crystal structure of the minerals. Analysis and interpretation of the data may lead to a clearer understanding between resistates in the soil and the levels of uranium and thorium in the environment. |
| ADDRESS | NIST<br>100 Bureau Dr.<br>Stop 8462<br>Gaithersburg, MD 20899-8462 USA<br>Phone: +1-301-975-5541<br>Fax: +1-301-926-7416<br>kenneth.inn@nist.gov |
| CONTACT | K.G.W. Inn |

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| LABORATORY | National Institute of Standards and Technology |
| NAMES | R. Collé and B.E. Zimmerman |
| ACTIVITY | Radionuclidic microcalorimetry for absolute standardizations |
| RESULTS | A primary standardization capability by classical microcalorimetry has been re-established at NIST in the past two years. The Radioactivity Group's current interest in the use of calorimetry for radionuclidic metrology derives directly from the need to provide standardizations for rather large GBq-range brachytherapy sources. In addition to the dual-compensated cryogenic calorimeter operating at a nominal 8 K, a commercial "isothermal [*sic*] microcalorimeter" has been adapted and evaluated for use in performing such classical calorimetric-based standardizations. This dual-cell, near-isothermal (heat flow) calorimeter operates at near-ambient temperatures; utilizes specially-fabricated source-holder cells that are used to maximize the energy absorption of the ionizing radiation; and incorporates resistance heaters within these measurement cells to obtain very-accurately-determined, independent power calibrations. Evaluations were initially performed on two different types of intravascular brachytherapy sources that contain nuclides that decay by pure β emission, *viz*., (*i*) a stainless- steel-jacketed $^{90}$Sr-$^{90}$Y source with a highly-refractory ceramic-like inner matrix, and (*ii*) a "hot-wall" balloon catheter source that consists of a thin film of $^{32}$P enveloped between polyethylene walls. The measured thermal power was related to source activities through the use of calculated average energies per decay, and was compared against "known" source activities that were determined from previous radioanalytical destructive assays. Monte Carlo calculations for the energy deposition in the measurement cells were used to assess and correct for possible power losses due to escaping ionizing radiation. This verification work clearly demonstrated, quantitatively, that the "isothermal" microcalorimeter was sufficiently efficacious for performing primary calibrations. This was achieved, in large part, by completing the development of the instrumentation and the protocol for better-than-0.1 % "absolute" power calibrations (based on joule heating with 0.001 % precision resistors). More recently, the calorimeter was used to provide primary standardizations for a new generation of aluminum-cored $^{90}$Sr-$^{90}$Y intravascular sources and for seeds containing $^{103}$Pd, a 17-day electron-capture-decaying nuclide that is used for the treatment of prostate cancer. The latter two standardizations were again confirmed by destructive, liquid-scintillation-based, assays. |

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| PUBLICATIONS | R. Collé and B.E. Zimmerman, A dual-compensated cryogenic microcalorimeter for radioactivity standardizations, *Appl. Radiat. Isot.* 56, 223-230 (2002).<br><br>R. Collé, B.E. Zimmerman, and R.E. Elmquist, Use of a dual-cell, near-isothermal (heat flow) calorimeter for radioactivity standardizations, to be published. |
| ADDRESS | NIST<br>100 Bureau Dr.<br>Stop 8462<br>Gaithersburg, MD 20899-8462 USA<br>Phone: +1-301-975-5527<br>Fax: +1-301-926-7416<br>rcolle@nist.gov |
| CONTACT | R. Collé |

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| LABORATORY | National Institute of Standards and Technology |
| NAMES | R. Collé |
| ACTIVITY | Ionization-chamber-based calibrations of brachytherapy sources of $^{90}$Sr-$^{90}$Y and $^{32}$P |
| RESULTS | Considerable work has continued on providing NIST-based activity calibrations for manufacturers of brachytherapy sources. More specifically, in the past year, ionization-chamber-based calibrations (using previously established calibration factors from primary standardizations) were performed for a set of old-style $^{90}$Sr-$^{90}$Y Novoste seeds. As noted above, the results of comparable calibrations performed at the same time on additional seeds were also used as a test of the microcalorimeter. The mean activity value derived from four replicate calorimetric measurements at a power level of about 25 μW agreed with the ion chamber results to about 1 %. This work clearly established the uncertainty limits attainable as a function of the power level for negligibly-decaying nuclides. Because of the long $^{90}$Sr half-life, these results are wholly dependent on the reproducibility of the calorimeter's power baseline or on the number of replications used to obtain a well-determined central value for the difference between the in-source power level and the baseline. A "last" set of ionization-chamber-based calibrations for Radiance balloon catheters was also performed. This calibration served as the basis for evaluating the calorimetric measurement of a combusted balloon. The agreement between the calorimetry and ionization-chamber assigned activity was approximately 0.5 %. This work established some of the "heat defect" restrictions in the composition of sources that can be used for calorimetry due to the effects of radiation chemistry. |
| PUBLICATIONS | R. Collé, Chemical digestion and radionuclidic assay of TiNi-encapsulated $^{32}$P intravascular brachytherapy sources, *Appl. Radiat. Isot*. 50, 811-833 (1999).<br><br>R. Collé, B.E. Zimmerman, C.G. Soares and B.M. Coursey, Determination of a calibration factor for the nondestructive assay of Guidant $^{32}$P intravascular brachytherapy sources, *Appl. Radiat. Isot*. 50, 835-841 (1999).<br><br>B.M. Coursey, R. Collé, B.E. Zimmerman, J. Cessna and D.B. Golas, National radioactivity standards for beta -emitting radionuclides used in intravascular brachytherapy, *Int. J. Radiat, Oncol. Biol. Phys*. 41, 207-216 (1998). |

R. Collé, On the radioanalytical methods used to assay stainless-steel-encapsulated, ceramic-based $^{90}$Sr-$^{90}$Y intravascular brachytherapy sources, *Appl. Radiat. Isot*. 52, 1-18 (2000).

R. Collé, Calibration of $^{32}$P "hot-wall" angioplasty-balloon-catheter sources by liquid-scintillation-spectrometry-based destructive radionuclidic assays, *Appl. Radiat. Isot*. 54, 611-622 (2001).

R. Collé, R., Activity characterization of pure-β-emitting brachytherapy sources, *Applied Radiation Isotopes*, 56, 331-336 (2002).

ADDRESS

NIST
100 Bureau Dr.
Stop 8462
Gaithersburg, MD 20899-8462 USA
Phone: +1-301-975-5527
Fax: +1-301-926-7416
rcolle@nist.gov

CONTACT

R. Collé

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| LABORATORY | National Institute of Standards and Technology |
| NAMES | R. Collé and B. E. Zimmerman |
| ACTIVITY | New primary standardizations of brachytherapy sources of $^{90}$Sr-$^{90}$Y and $^{103}$Pd |
| RESULTS | This work marks the first calorimetry-based radionuclidic standardizations that have been performed by the NIST Radioactivity Group in 35 years. The first standardization was for a batch of 16 of the new-style $^{90}$Sr-$^{90}$Y Novoste seeds. The calorimetry of these new style seeds was also directly compared to a liquid-scintillation-based destructive assay on a relatable seed. The calorimetric result for only three replicate determinations at a power level of about 60 μW agreed with assayed activity to 0.7 %. The second was a primary standardization for $^{103}$Pd and a Theragenics prostate seed calibration that was based on a very-complex experimental design. The work involved preliminary ionization chamber measurements on two levels of seeds, calorimetry on the high level seeds, photonic emission spectrometry of both seeds and prepared sources, a digestion of both types of seeds followed LS efficiency tracing against $^{54}$Mn and TDCR LS counting. Major $^{103}$Pd decay scheme discrepancies have become apparent. Nevertheless, the calorimetric results (assuming that the average energy per decay is known) has an uncertainty of about 0.6 % and agrees with the LS efficiency tracing results to about 2% (which is about the uncertainty on the LS results). The LS TDCR results are in a further 2 % disagreement, but the calculational model is known to have a systematic error (due to phototube asymmetries) of unknown magnitude. Part of the $^{103}$Pd standardization work involved international collaborations with R. Broda from POLATOM and P. Cassette from France's LNHB and measurement intercomparisons with LNHB. |
| ADDRESS | NIST<br>100 Bureau Dr.<br>Stop 8462<br>Gaithersburg, MD 20899-8462 USA<br>Phone: +1-301-975-5527<br>Fax: +1-301-926-7416<br>rcolle@nist.gov |
| CONTACT | R. Collé |

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| LABORATORY | Institute of Occupational and Radiological Health "Dr Dragomir Karajović" |
| NAMES | G. Pantelić, I. Tanasković, Lj. Javorina, M. Eremić Savković,V. Vuletić |
| APPARATUS | Low-bacground HP Ge detector;<br>Pop-top HP Ge detector;<br>NaI(Tl) detector;<br>Gas flow proportional counter. |
| ACTIVITY | Preparation, quality control and standardization of solutions of several radionuclides for gamma-ray spectrometry;<br>Participation in international comparisons (EML New York, ALMERA Vienna);<br>Routine measurements of radionuclides in environmental samples;<br>Routine measurements and certifications of radioactive contamination in imported or exported foodstuffs;<br>$^{222}$Rn measurements in homes and workplaces. |
| RESULTS | More then 300 samples from contaminated areas have been measured for uranium. Contamination from depleted uranium has been found in soil samples, lichens and moses. |
| PUBLICATIONS | 1. M. Krmar, G. Pantelic, Z. Djurcic: Endpoint Energy of Therapy Accelerators: Determination and Control by Activation Technique, Medical Physics, Vol. 29, No. 6, 2002, 1200<br>2. *G.K. Pantelic, I.K. Petrovic, M.M.Eremic, S. Milacic*: Radiation Protection Monitoring in the Vicinity of Coal-Fired Power Plants, High Levels of Natural Radiation and Radon Areas: Radiation Dose and Health Effects, Volume II, Proceedings of the 5$^{th}$ International Conference on High Levels of Natural Radiation and Radon Areas held in Munich, 2002, 328-330 |
| ADDRESS | Institute of Occupational and Radiological Health "Dr Dragomir Karajović", Deligradska 29, 11000 Belgrade, Yugoslavia<br>Tel: ++381-63-8470743<br>Fax: ++381-11-643-675<br>E-mail: dpantelic@ptt.yu |
| CONTACT | Gordana Pantelić |