Report on the EURAMET Ionising Radiation technical Committee activites 2007-2009 to the 19th CCRI(I) and 20th (CCRI(II) meetings

István Csete (Hungarian trade Licensing Office) Euramet IR TC chair

1. IR TC members and their status

Since the last report issued in 2007, the composition and scientific activity of Ionising Radiation Technical Committee has changed a few as it can be seen in table below. The last 4 from the 17 designated institutes are passive, even if two of them have published CMCs. The Rudjer Boskovic Institute (IRB) form Croatia intend to be designated status. The status of the IAEA Dosimetry Laboratory has not yet clarified. A new EURAMET Guide No. 10. http://www.euramet.org/index.php?id=guides was issued in 2008 inform the top level management of NMIs and respective ministries for the national metrology infrastructure, membership criteria etc. Some statistic about the IR TC are in the table below.

	Published CMCs	neutron	dosimetry	activity	EMRP mem.	ERANET+ TP2 J06/J07	Status DI/NMI	NMI/country
	Total	**115**	**605**	**1067**	**21**	**10/8**	**17/12**	**31**
1	CIEMAT (ES)		36	97	*		DI	CEM/Spain
2	IFIN (RO)			34	*		DI	INM/Romania
3	SMU (SK)	15	58	37	*	/*	NMI	SMU/Slovakia
4	RMTC(LV)		12	131			DI	LNMC/Latvia
5	NRPA(NO)		22		*		DI	JV/Norway
6	NCM(BG)		7				NMI	NCM/Bulgaria
7	NPL (UK)	38	41	121	*	*/*	NMI	NPL/UK
8	PTB (DE)	26	59	0	*	*/*	NMI	PTB/Germany
9	LNE-LNHB (FR)	15	61	160	*	*/*	NMI	LNE/France
10	IRMM (EC)			85	obs.		A-GA	EC
11	IAEA		13				?	UN
12	BEV (AT)		49	74	*	*/	NMI	BEV/Austria
13	CMI (CZ)	12	7	104	*	*/	NMI	CMI/Czech Rep.
14	METAS (CH)		8		*		NMI	METAS/Switzerland
15	NMi (NL)		28	57	*	*/*	NMI	Nmi/Netherland
16	MKEH (HU)		20	74	*		NMI	MKEH/Hungary
17	ENEA (IT)	9	76	14	*	*/*	DI	INRIM/Italy
18	GUM (PL)		5				NMI	GUM/Poland
19	STUK (FI)		31		*	*/*	DI	MIKES/Finland
20	ITN (PT)		43		*	*/*	DI	IPQ/Portugal
21	SSM (SE)		29		*	*/	DI	SP/Sweden
22	RPII (IE)						DI	NML/Ireland
23	DTU (DK)				*		DI	DFM/Denmark
24	SZMDM (YU)						NMI	DMDM/Serbia
25	IJS (SI)				*		DI	MIRS/Slovenia
26	GAEC						DI	EIM/Greece
27	IRB (HR)						DI?	DZM/Croatia
28	LNE-IRSN (FR)				*		DI	LNE/France
29	Polatom (PL)			58	*		DI	GUM/Poland
30	TAEK				*		DI	UME/Turkey
31	IRA (CH)			21	*		DI	METAS/Switzerland
32	GR (IS)						DI	NEST/Iceland

Projects

There are 11 running and one proposed projects of the IR TC in the period of review from 2007 to date. Some details are in the table below.

Project No.	Type	Subfield	No. of. part.	Pilot lab.	Status	Duration
1085	Co-operation in research	activity	6	LNH-LNHB	Measurements in progress	2009-2010
907	RI(II)-S5.Sb-124 compari-son	activity	9	LNE	Measurements completed, Draft A report in progress	2006-2009
749	Co-operation in research	activity	5	IRMM	Final report in progress	2004-2009
608	RI(III) S1 comparison	neutron	3	IPSN	STOPPED!	2002-
822	RI(III) S2 comparison	neutron	3	PTB	Measurements completed Draft A report in progress	2004-2009
936	comparison	neutron	3	NPL	Measurements in progress	2008-2009
?	comparison	neutron	4	?	proposal	2009-
1021	comparison	dosimetry	3	BEV	Measurements in progress	2008-2009
813	RI(I)-K1&K2 comparison	dosimetry	26	MKEH	Measurements completed Draft A prepared	2005-2009
738	RI(I) S5 comparison	dosimetry	17	PTB	Measurements completed Draft A in progress	2005-2008
628	Comparison	dosimetry	4	NPL	Measurements in progress	2005-2009
605	Co-operation	dosimetry	6	METAS	Final report in progress	2004-2009

2.1 Co-operations in research:

Project 1085: Standardization, decay data measurements and evaluation of ^{64}Cu

The aims of the project to create copper 64 national activity standards able to be transferred to practitioners in the medical field through secondary standards, to determine with high accuracy decay data such as branching ratios, photon emission intensities and half-life, and - to issue an updated evaluated decay scheme, based on former published results and on those coming from the project. The comparison measurements part of the project to ensure the traceability are running as a CCRI(II) key comparison. Participants are LNHB (FR), NPL (UK), PTB (D), SMU (SK), IFIN (RO), CMI (CZ)

Project 749: Alpha–particle emission probabilities and energies in the decay of ^{240}Pu

The measured alpha and gamma spectra involved different techniques have been performed. From the measured gamma spectra additional information on the alpha particle emission was derived at the IRMM. The emission probability and other decay data calculation have been performed by IRMM,CIEMAT and UNEX. The final report is preparing by the IRMM and scheduled by June 2009 .

Project 605: Beam Quality Specification of High- Energy Photon beams

A set of four cylindrical ionisation chambers belonging to METAS (two of type NE2571A, one of NE2561 and one of NE2611A) have been calibrated in terms of absorbed dose to water in the ^{60}Co beams and in several high-energy X-ray beams in the range 4 MeV-21 MeV at participating laboratories (ENEA, LNHB, METAS, NPL, NRC and PTB). Beam quality measurements have been performed in the accelerator beams in order to compare the effi-

cacy of $TPR_{20,10}$ and $\%dd(10)_x$ terms as beam quality specifiers. The measurements and data analysis have been completed in 2007. The MC simulation of the METAS accelerator beams including the beam quality specifier was completed in 2008. The analysis of the data is completed and the final discussion among the participants is ongoing. The final the report will be ready by June 2009. A paper on the basis of the final report will be submitted to PMB.

2.2 Comparisons

Project 1021: Direct comparison of primary standards of absorbed dose to water in ^{60}Co and high energy photon beams

This project is proposed for the direct comparison of primary standards for absorbed dose to water of BEV, METAS and PTB in ^{60}Co and high energy photon beams. The primary standards for application in this comparison are one graphite calorimeter (BEV) and two water calorimeters (METAS, PTB). The BEV transported its graphite calorimeter primary standard to METAS and PTB and completed the measurements at ^{60}Co, 4 MeV, 6 MeV, 10 MeV and 15 MeV photon beams. The PTB characterization of the 4 MeV beam and the evaluation of measurement data is in progress.

Project 936: Comparison of long counter (LC) measurements of monoenergetic neutron fluences.

To date no comparison of LC neutron fluence measurements has been performed, and IRSN, PTB, and NPL propose to hold one. Not all LCs are identical. The participants have 4 LCs, two near identical commercial instruments, and two home-made instruments. The applied neutron beams were the Am-Be, Am-B, Am-F, Am-Li, and Cf-252 sources and 144 and 565 keV, 1.2, 5.0 and 17.0 MeV monoenergetic beams. The outcomes are expected to be improved understanding of the measurements and better knowledge of the efficiencies and effective centres. This in turn will lead to reduced uncertainties and greater confidence in long counter results. The comparison measurements have been performed at NPL involving staff from PTB and IRSN. The preliminary analysis has been completed and further data required for evaluation are collecting from the labs.

Project 907: EUROMET.RI(II)-S5.Sb-124 Measurement of Sb-124 activity and determination of photon emission probabilities.

The first part of this exercise was dedicated to activity measurements, the 9 participants were asked to use all techniques available in their laboratory. The ampoules of Sb-124 were sent to the participants in March 2007.The second part is dedicated to gamma-ray measurements. The participants have already sent their data to LNE-LNHB where the decay data evaluation completed. The Draft A report has been written and sent to the participants. A summary of this exercise has been submitted to ICRM conference. The expected completion of the project is July 2009.

Project 822: EUROMET RI(III)-S2 Comparison of neutron fluence measurements for neutron energies of 15.5, 16, 17, 19 MeV

The determination of the neutron fluence in quasi-monoenergetic neutron fields at neutron energies using primary standard instruments of the participating laboratories (PTB, NPL, IRMM) started in 2005. The involved neutron fields were available at the accelerator facility of PTB in Braunschweig. The measurements have already been completed. The extra TOF measurements

and further calculations were also performed. Draft A accepted, final report is expected in June 2009

Project 813: EUROMET RI(I)-K1&K2 Comparison of air kerma and absorbed dose to water measurements of ^{60}Co radiation in radiotherapy

The high stability transfer instruments have enabled the 26 participants to establish their degrees of equivalence, DoE, of their national standards for air kerma (K_{air}) and absorbed dose to water (D_w). The new 11 K_{air} and 14 D_w DoE values are able to support the relevant CMC claims of the participants. The average calibration coefficient values used for these calculations, conveyed DoE values to be within the expanded uncertainty of DoE of each participant for both quantities except the three cases for air kerma. The Draft A report is circulating, final report is expected in May 2008.

Project 738: EUROMET RI(I)-S5 Intercomparison of the personal dose equivalent (H_p10) for photon radiation

All the laboratories which have CMC lines for personal dose equivalent quantity for X-ray beam qualities have joined (except ENEA) and completed the measurements by February 2008. Preliminary evaluation of the 15 results shows a good agreement within the stated uncertainties. The Draft A is under circulation final report is expected in 2009.

Project 628: Direct comparison of primary standards of air kerma for medium energy (300 kV) X-rays

The PTB, VSL and NIST have already completed the comparisons involving the BIPM reference beam qualities, the ISO 4037 narrow beam qualities and IEC 61267 RQR, RQA beam qualities. New project coordinator was appointed at NPL. Available results will be published before the end of 2009.

Project 608: EUROMET RI(III)-S1 Test program of instrument calibrations for neutron dosimetry

The project was ceased in 2008 having several technical problems. The results of IRSN, SCK, KRISS, CMI, IEA, SMU who have already performed the comparison measurements would be published. New comparison program with similar task would be organised for NPL, PTB, VNIIM, CIAE and further potential participants as EURAMET supplementary comparison.

Project 545: EUROMET RI(I)-S3 Comparison of national air kerma standards for ISO 4037 narrow spectrum series in the range 30kV to 300kV

The comparison program and its final report has been completed. The results of 10 participants can support the relevant CMC lines enabling calibration of radiation protection dosemeters not only in term of air kerma but in term of ambient dose equivalent as well.

2. Participation in iMERA-Plus

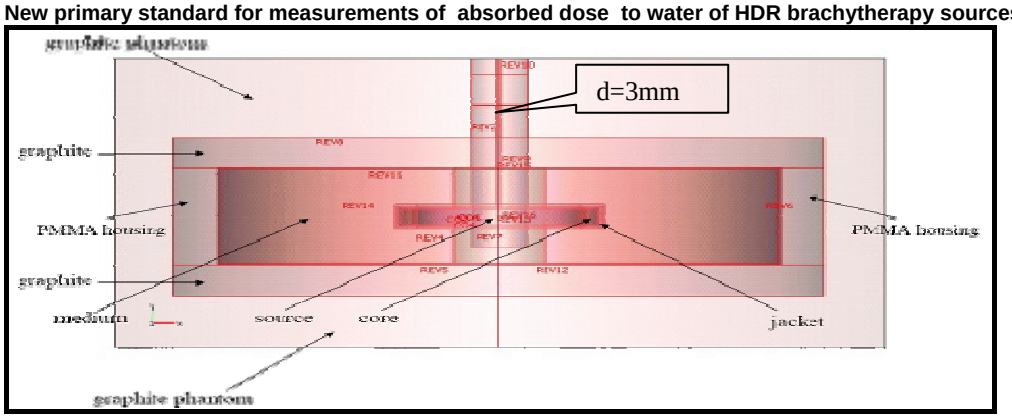
In addition to the traditional types of collaboration projects the execution of IR part of EMRP has been launched in the frame of ERANET-plus program. Both dosimetry projects are related to cancel radiation treatment.

As part of the **Health Targeted Program** the project **T.2J07** title **"External Beam Cancer Therapy"** (EBTC) launched with 8 participants on 1 April 2008.The objective of the project is to provide reliable measuring technique and metrology background for cancer therapy based on high intensity therapeutic ultrasound (**HITU**), proton and heavier ion beam (**Hadron**), and intensity modulated high energy photon (**IMRT**) external radiations. One of the major challenge is to measure

the absorbed dose to water quantity in small (2×2 cm) radiation beam. Project co-ordinator is Hans Michael Kramer (**PTB**). The website of the project is *http://bscw.ptb.de* The first project meeting was held in Rome on 7-8 October in parallel with the thematically related T2.J06 "Brachytherapy" project. A joined workshop involving the colleagues from ultrasound measurements was also organised.

The other IR project, **T2.J06** title "**Increasing Cancer treatment efficacy using 3D brachytherapy**" (Brachytherapy) has also launched with 10 participants and 3 not funded collaborators. The final task of the project is to measure the absorbed dose to water in the vicinity (1cm) of the brachytherapy source with uncertainty less than 2% (k=1) and accurate determination of 3D dose distribution. According to the low (**LDR**) and high activity sources (**HDR**) used, three new ionometric (extrapolation ionisation chamber), and four calorimetric (graphite and water calorimeter) primary standards are under development respectively. The project is coordinated by Maria Pia Toni **(ENEA)**.The website of the project is *http://brachytherapy.casaccia.enea.it*. Schematic outline of the new ENEA brachytherapy calorimeter for measurements of absorbed dose to water of ^{192}Ir HDR seed can be seen in figure below.

New primary standard for measurements of absorbed dose to water of HDR brachytherapy sources



Publication and communication facility for the two IR Eranet-Plus JRPs was developed at the restricted area of EURAMET IR website. The first JRP periodic progress reports have been issued and uploaded to the EURAMET IR website. The two projects currently under way in the field of dosimetry are progressing according to schedule. The next project meetings are scheduled for the next couple of weeks, i.e. 30/31 march 2009, Braunschweig for T02:J06 'Brachytherapy' and 20/21 April 2009, Istanbul 'EBCT'. In these meetings possible deviations from the schedule will be identified, the consequences for the projects or parts of them will be assessed.

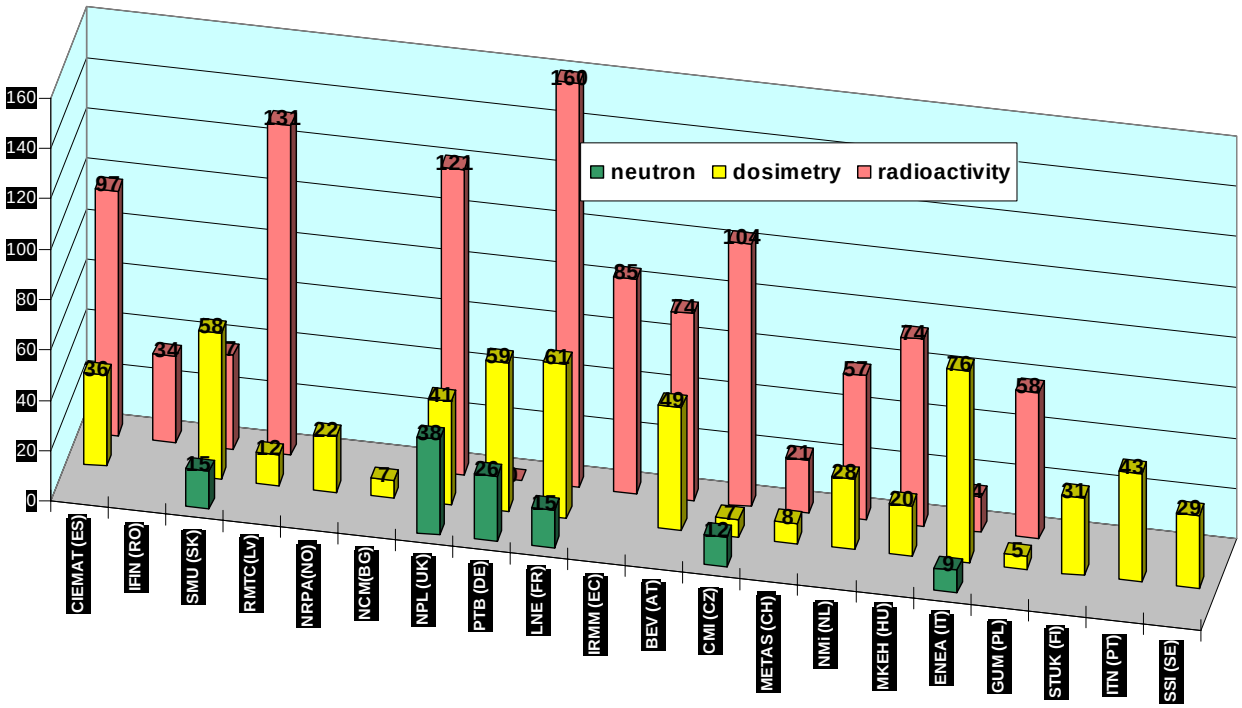
3. MRA CMC

The revised EURAMET Guide No. 8. http://www.euramet.org/index.php?id=guides was issued in 2008 about the procedure and review criteria for CMCs.

From the 31 IR laboratories 23 have published CMC. Further five laboratories intend to publish service lines. The PTB dosimetry claims (89) published in 2005 have been reviewed, and the radioactivity claims (158) drafted in 2001 finally are under inter RMO review. file name **RI.9.2009**. Some statistics from the published IR CMC claims (1774) can be seen in the table and figure below.

Published CMCs

Subfield	JCRB file name	Date of publication	NMIs	Claims
Radioactivity	RI.1.2001	15/09/2003	10	768
	RI.6.2006	18/01/2007	1	131
	RI.8.2007	15/05/2008	3	168
Dosimetry	RI.3.2001	11/03/2005	13	460
	RI.7.2006	06/10/2006	1	1
	RI.6.2006	18/01/2007	1	12
	RI.5.2006	14/02/2007	2	28
	RI.8.2007	15/05/2008	2	94
Neutron meas.	RI.4.2001	19/05/2005	5	99
	RI.8.2007	15/05/2008	1	15



Pending EUROMET IR CMC claims in different phases:

Internal review: Greece (dosimetry),
Inter RMO review Germany (activity+dosimetry)
Under prep.: Croatia (dosimetry)

IR TC review of other RMO's new CMCs in 2007-2008

Subfield	RMO/country/NMI	Num. NMIs	Num. claims
Dosimetry	APMP/Malaysia/MNA	1	22
Dosimetry	SIM/Brazil/IRD	1	8
Activity	SIM/ Argentina/CNEA	1	2
Activity	SIM/Mexico/ININ	1	43
Total		4	75

From last February there was no any inter RMO review of IR claims.
According to the three subfields within the IR TC, three CMC working groups have been working led by the three convenors listed below:

Dosimetry: **T. Aalbers** *(NL),* H.- M. Kramer *(D)* ,H. Bjerke *(No)*, C. Hourdakis *(Gr)*,), J.-M Bordy *(Fr)*
Radioactivity: **Burno Shauvenet.** *(Fr)*, F.-J. Maringer *(AT)*, Jose M. de Los Arcos *(ES),*
Neutron: **M. Kralik** *(Cz)*, L. van Ryckeghem *(Fr)*

The co-operation and communication between EUROMET and the other RMOs colleagues concerning the review procedures are efficient. Most of our comments on technical details of claims have been appreciated and expected. However, to know details of other RMOs' QS system (database?) would be an advantage to harmonise the field specific QS requirements of CMC claims acceptance. Publication of new IR CMCs by other RMOs has slowed in recent years.

MRA Key comparisons

The nine primary dosimetry laboratories are taking part in the ongoing BIPM.RI(I) K1-K5 comparisons for air kerma of ^{60}Co,^{137}Cs, low and medium energy X-rays, as well as absorbed dose to water of ^{60}Co radiations.
The twelve primary radioactivity laboratories are also taking part in most of the ongoing 63 BIPM.RI(II) K1 (SIR) type and 25 CCRI(II) K2.type key comparisons. There is no running supplementary radioactivity comparison.
Unfortunately, **there is no running neutron key comparison**. The two supplementary comparisons are co-ordinated by EUROMET.

4. Meetings and Workshops

- The „**CCRI(II) activity uncertainty and comparisons" workshop** was held at the BIPM 17-18 September, 2008. There were 35 participants coming from laboratories having primary standard for radioactivity measurements. The first day was dedicated to the uncertainty calculation of available primary standardization measuring techniques. The 12 extensive scientific reports covered all the significant components of uncertainty budget. At the second day the 21 presentations, delivered by the key comparison participants, discussed the measuring and data evaluation issues of running key comparisons of I-125; Fe-55; P-32; Kr-85; 3H radionuclides. The presentations were uploaded to the BIPM website.
- The **5th International Conference on Radionuclide Metrology Low-Level- Radioactivity Measurement Techniques (ICRM LLMT) conference** were held at Braunschweig 22-26 September 2008. There were 120 participants from 25 countries world-wide, 25% of participants were coming from NMIs. The 100 presentations cover the following topics: Quality ; Radiochemical techniques; Radiometrics;

Gamma-ray spectrometry; Ultra Low Level gamma-ray spectrometry; Scintillation counting, alpha spectrometry; Non-radiometric measurements (ICP-MS); Radon (Rn-220 ; Rn-222) ;Applications. The conference proceedings will be published in the *Applied Radiation and Isotopes.*

- The **yearly IR TC CP meeting** of all the three subcommittee was held on 9-10 October 2008 in Casaccia, Italy, hosted by the INMRI-ENEA. All the presentation of the 23 participant NMIs and designated institutes as well as other documents referred to in the agenda are available on the restricted area of EURAMET IR TC website. Guests from BIPM and participants of the second meetings of JRP T2.J06 and T2.07 organised to the previous two days were invited. In addition to the usual issues, extensive progress reports on “Increasing Cancer Treatment Efficacy using 3-D Brachytherapy” and “External beam Cancer Therapy” iMERA-Plus projects were presented. NMis being not member of the actual two consortiums, expressed their interest on better information flow from research work executing the EMRP. Hans Bjerke (No**)** and Franz Josef Maringer (AT) were proposed as candidates for nomination for **new TC chair**. The EURAMET delegates have elected **Hans Bjerke,** who will act from 10 June 2009. The **IR EMRP Task Group** agreed on to hold a meeting at NPL on 18 November, focusing on the IR challenges of ENERGY targeted programme. Nomination of three convenors is scheduled at next year’ meeting. The next IR TC CP meeting will be held at the LNE-LNHB , Paris on 15-16 October 2009 just after the next periodic meetings of IR iMERA-Plus projects participants to be time and cost effective fostering the better information exchange as well.

- **5. Strategic planning, organisation and research challenges**
  - Concerning intra RMO CMC review, a specific IR procedure, which cases and how the **onsite visit by peers** of laboratories shell be arranged and documented, has been drafted according to the EURAMET guides No. 8 and CIPM Recommendation 2007-25.
  - As a result of the IR EMRP task group meeting a new roadmap on the topic "energy" has been developed dealing with future technologies like fusion and nuclear energy production, waste management, decommissioning etc. Some labo-

ratories (NPL, PTB, LNE-LNHB, CMI) in countries with nuclear power plants and open questions on radioactive waste disposal, have drafted a proposals covering the fields of radioactivity, neutron metrology and radiation protection issues.The next call for Joint Research Projects dedicated to the **metrology for "ENERGY"** as further execution of EMRP, will start on 31 August 2009. This targeted program probably will be funded by EC with 50% of the 34 M€ budget, on the basis of Article 169. The IR TC prepared three proposals:

i. *Development of primary and secondary standardisation methods, improved nuclear data for radionuclides related to the new reactor types (tritium, actinides etc.)*
ii. *Development of neutron fluence, spectrometry and cross sections measurement related to nuclear fusion.*
iii. *Development of proficiency testing methods and certified reference materials for traceable measurement of radioactive waste materials according to the EC, NEA and IAEA recommendations.*

István Csete
IR TC chairperson