

## **EUROMET activities in the field of neutron measurements**

**Reporting period: May 2003 - May 2005**

**Prepared by Horst Klein and Miloslav Kralik**

### **European metrology institutes involved in neutron measurements**

At the beginning of the reporting period, i.e. in 2003, EUROMET metrology institutes dealing with neutron measurements were as follows:

LNE, France: linked or associated laboratories are authorised for particular neutron measurements, namely:  
LNHB, Saclay – emission rates of radionuclide neutron sources,  
IRSN, Cadarache - calibrations in terms of dose equivalent quantities.

CMI, Czech Republic

ENEA, Italy

NPL, UK

PTB, Germany

SMU, Slovakia

STUK, Finland

### **Review of EUROMET CMC tables**

At the meeting of Syndicate Group 'Neutron Measurements' at ITN, Sacavem/Lisbon, 11 October 2002 the team of reviewers for EUROMET neutron CMCs were agreed:

Horst Klein, PTB (convenor),

Miloslav Kralik, CMI,

Laurent Van-Ryckeghem, IRSN.

LNE	France	(15 entries)
CMI	Czech Republic	(12 entries)
ENEA	Italy	(9 entries)
NPL	UK	(37 entries)
PTB	Germany	(26 entries)
SMU	Slovakia	(6 entries)
STUK	Finland	(All entries were removed)

STUK, Finland, suspended neutron measurements completely in 2003 so their neutron CMCs were removed from the reviewing procedure.

All European institutes put their CMC tables (105 entries in total) into the reviewing procedure in November 2001 except the SMU, Slovakia, which delivered CMCs in October 2002. Editing of LNE, CMI, ENEA, NPL and PTB neutron CMCs were finished in March 2005 and now they are placed at the JCRB web site. Relevant comments of other RMOs were taken into account and also 'International Rules for Filling CMC Tables for Ionizing Radiation', updated on 24 September 2004, were followed. CMCs of SMU should still be corrected.

## **EUROMET review of CMC tables of others RMO**

EUROMET neutron CMCs reviewers team prepared assessment of APMP and SIM CMCs in March and COOMET in December 2004.

### **APMP**

Six APMP members submitted in total 58 CMCs for neutron calibration measurements:

AIST/NMIJ	Japan	(9 entries)
ANSTO/ARPANSA	Australia	(2 entries)
BARC	India	(31 entries)
INER	Taiwan	(4 entries)
KRISS	Republic of Korea	(9 entries)
NIM	China	(3 entries)

### **SIM**

Four SIM members submitted in total 11 CMCs for neutron calibration measurements:

ININ	Mexico	(1 entry)
LNMRI	Brazil	(2 entries)
NIST	USA	(6 entries)
NRCC	Canada	(1 entry)

### **COOMET**

Four COOMET members submitted in total 46 CMCs for neutron calibration measurements:

BelGIM	Belarus (Valerei Milevskiy)	(2 entries)
VNIIFTRI	Russia (Sergei Korostin)	(6 entries)
VNIIM	Russia (Igor Kharitonov)	(38 entries)

### **SADCMET**

We have no information on neutron measurement activities of this RMO.

Generally, all EUROMET comments have been accepted and considered in their revision.

## **Participation of EUROMET-laboratories in CCRI(III)- and EUROMET-comparison exercises**

EUROMET-laboratories engaged in neutron metrology and dosimetry participate in various recently completed, actually running or planned CCRI- or RMO-comparison exercises in order to compare their national standards and/or to support their calibration measurement capabilities (to be) listed in App. C of the BIPM-KCDB (see attached table)

## **Present status of Neutron measurements at EUROMET**

The activities in the field of neutron measurements are summarized in the attached table.

All laboratories offer services with well-characterised radionuclide neutron sources, chiefly for the calibration of neutron survey meters and partly also for proficiency tests of national personal dosimetry services.

Four laboratories are able to determine the emission rate of encapsulated radionuclide neutron sources LNE/LNHB, CMI, ENEA, NPL.

Only NPL and PTB can determine the energy dependent response of neutron sensitive devices with almost monoenergetic neutrons in a wide neutron energy range from thermal up to 20 MeV. LNE/IRSN has set up a new facility at Cadarache for this purpose.

PTB offers the unique service, calibrations in high energy ( $E_n > 20$  MeV) neutron fields

Only CMI offers measurement of the spectral fluence in the field, e.g. at workplaces for radiation protection purposes.

## **Co-operation with COOMET**

COOMET asked for a close co-operation between COOMET and EUROMET in the field of neutron measurements, e.g. participation in EUROMET-projects, because there are only very few laboratories of COOMET offering neutron calibration services, namely VNIIM in St. Petersburg, and VNIIFTRI in Moscow. At the 5<sup>th</sup> meeting of COOMET TC1.9 on April 25 and 26, 2005 at PTB, VNIIFTRI and PTB agreed on a bilateral project, to compare the different procedures used to determine the reference values of dosimetric quantities (absorbed dose to water, ambient and personal dose equivalent) in the calibration fields realised at VNIIFTRI and PTB with radionuclide neutron sources. No further joint activities in the field of neutron measurements were discussed.

<b>NEUTRON CALIBRATION MEASUREMENT CAPABILITIES OF EUROMET LABORATORIES</b>		
<b>Quantity</b>	<b>Neutron source</b>	<b>Laboratories</b>
Emission rate of sealed sources	<sup>252</sup> Cf Am-B Am-Be Am-F Am-Li Pu-Be Etc.	LNE/LNHB CMI ENEA NPL
Fluence rate	Mono-energetic ISO (24 keV - 19 MeV)	NPL PTB
	Quasi-monoenergetic, (20 MeV - 70 MeV)	PTB/UCL
	Thermal neutron beam	NPL (PTB)*
	Thermal standard (cavity)	ENEA
	Radionuclide neutron sources	LNE/IRSN CMI ENEA NPL PTB
Spectral fluence rate	(Workplace) neutron field (thermal - 20 MeV)	CMI
Ambient dose equivalent rate	mono-energetic ISO (24 keV - 19 MeV)	(NPL)** (PTB)**
	quasi-monoenergetic (20 MeV - 70 MeV)	PTB/UCL
	Radionuclide neutron sources (also <sup>252</sup> Cf (D <sub>2</sub> O-mod.))	LNE/IRSN CMI ENEA NPL PTB SMU
	Workplace field	CMI
Personal dose equivalent rate	Mono-energetic ISO ( 24 keV - 19 MeV)	(NPL)** (PTB)**
	Radionuclide neutron sources (also <sup>252</sup> Cf (D <sub>2</sub> O-mod.))	LNE/IRSN CMI ENEA NPL PTB SMU

\*) New calibration service in preparation.

\*\*\*) No separate CMCs listed in the KCDB. The values of dosimetric quantities are simply calculated from the fluence (rate) by multiplication with internationally agreed conversion factors.

## Participation of EUROMET-laboratories in key- and supplementary comparisons organised by CCRI(III) and EUROMET

<b>CCRI(III)-K1</b>	
Title:	Comparison of 24.5 keV neutron fluence measurements
Pilot laboratory:	NPL (V. Lewis)
Participants from EUROMET	NPL, PTB (2 out of 6)
Status:	Completed, but final report still in discussion.

<b>CCRI(III)-K8</b>	
Title:	Comparison of thermal neutron fluence measurements
Pilot laboratory:	NIST (D. Gilliam)
Participants from EUROMET	IRMM, NPL, PTB (3 out of 7)
Status:	New proposal in discussion

<b>CCRI(III)-K9.AmBe</b>	
Title:	Comparison of measurements of the emission rate of an Am/Be-neutron source
Pilot laboratory:	NPL (V. Lewis, N. Roberts)
Participants from EUROMET	LNE/LNHB, CMI, NPL (3 out of 7)
Status:	Measurements to be completed in June 2005.

<b>CCRI(III)-K10</b>	
Title:	Comparison of fluence measurements in mono-energetic neutron fields with neutron energies of 144 keV, 1.2 MeV, 5.0 MeV and 14.8 MeV
Pilot laboratory:	PTB (S. Guldbakke, H. Klein)
Participants from EUROMET	IRMM, NPL, PTB (3 out of 7)
Status:	Final report in progress.

<b>EUROMET.RI-S1</b>	
Title:	Comparison of the calibration of neutron survey instruments in the fields of radio-nuclide neutron sources
Pilot laboratory:	IRSN (L. van Ryckeghem)
Participants from EUROMET	CMI, LNE/IRSN, NPL, PTB, SMU, IAE, IRMM (7 out of 11)
Status:	Delayed due to technical problems.

<b>EUROMET.RI-S2</b>	
Title:	Comparison of fluence measurements in mono-energetic neutron fields with neutron energies from 15.5 MeV to 19 MeV
Pilot laboratory:	PTB (R. Nolte)
Participants from EUROMET	IRMM, NPL, PTB (3 out of 3)
Status:	Measurements completed, evaluation in progress.