

**Progress report on the radioactivity measurements in the Czech Metrology Institute  
(2001 to March 2003)**

The traceability in the field of radioactivity measurement for the Czech Republic is provided by CMI-Inspectorate for Ionizing Radiation. The primary standardization is provided by the laboratory for absolute measurement which supports the department for production of standards.

The systems for absolute measurement are:

- $4\pi$   $\alpha, \beta$ - $\gamma$  proportional counter with two NaI(Tl) crystals
- $4\pi$   $e, X, \beta$ - $\gamma$  press. proportional counter with two NaI(Tl) crystals
- $4\pi$   $\gamma$  windowless NaI(Tl) counter
- liquid scintillation counter

The secondary standardization systems are:

- HPGe gamma spectrometr
- $4\pi$  gamma ionization chamber
- liquid scintillation counter

The secondary standardization systems are calibrated mainly by own standards and serves also for the cross checking of absolute measurement results.

Most of work has the routine character and consist of the standardization of radionuclide solutions for the production of standards. More then 30 radionuclides were standardized in last two years. The number of commercial standards was more then 1200, about 400 for export.

CMI has participated in international actions:

- CCRI(II) comparison of  $^{152}\text{Eu}$ ,  $^{65}\text{Zn}$ ,  $^{241}\text{Am}$
- NPL international intercomparison of  $^{18}\text{F}$  activity
- interlaboratory comparison CMI – RC-Swierk, Poland of activity measurement on the environmental level
- CMI organized EUROMET project E634 -Common calibration of ionization chambers- (participants were Czech Republic, Austria, Slovak Republic) with radionuclides  $^{18}\text{F}$ ,  $^{67}\text{Ga}$ ,  $^{99\text{m}}\text{Tc}$ ,  $^{123}\text{I}$ ,  $^{131}\text{I}$  and  $^{201}\text{Tl}$
- S.I.R. intercomparison of  $^{131}\text{I}$
- Workshop NURAHYD-1, Luxemburg, measurement of the radon in the water, CMI prepared radon-water (without radium). Rn activity was based on the known  $^{226}\text{Ra}$  activity from which all radon was diluted into the water. The average of ten participants result's was only 2% from CMI value .

Development of new methods.

The Monte Carlo modeling with MCNP code was applied for the calculation of the efficiency of the  $4\pi$  gamma ionizing chamber and HPGe detector and compared to the experimental results. Discussion of discrepancies is under way. The modeling of HPGe efficiency is more successful then modeling ionization chamber efficiency.

The secondary standardization of  $^{85}\text{Kr}$ ,  $^{133}\text{Xe}$  and  $^{41}\text{Ar}$  was developed for the calibration of devices in nuclear power plants. The calibrated HPGe spectrometr is used for activity

measurement of the small amount of gas. Calibration points are  $^{85}\text{Sr}$  for  $^{85}\text{Kr}$ ,  $^{133}\text{Ba}$  for  $^{133}\text{Xe}$  and  $^{60}\text{Co}$  for  $^{41}\text{Ar}$ . The volume activity is calculated also from the exact measurement of the pressure, volume and temperature.

CMI has worked in the field of Digital Coincidence Counting. Consultation to John Keightley, NPL is expected. The differences of DCC from classic coincidence method for  $^{60}\text{Co}$  were 0.031, 0.091 and 0.063 % in three separate sets of measurement.

There has been established the new spectrometric chain with Digital Signal Processor DSP9660. Properties of DSP (integral, differential linearity, channel profile and dependence of FWHM and peak area on the count rate) were compared to Wilkinson and fixed dead time ADC's. Results will be presented at ICRM2003 conference.

Metrology service.

CMI organize every year the comparisons of activity measurements in nuclear medicine with radionuclide calibrators in the Czech Republic. The general result is: now more than 96% hospitals are in the limit  $\pm 10\%$  in case of  $^{67}\text{Ga}$  and  $^{99\text{m}}\text{Tc}$  and  $^{131}\text{I}$ . When CMI started this service ten years ago, the deviation up to 200 % were observed.

Accreditation.

The department for production of radioactive standards has certified Quality System under Standard ISO 9001:1994 by certification body DET NORSKE VERITAS. The certification under Standard ISO 9001:2000 is in progress.

The General Director of the Czech Metrology Institute herewith declares, in implementation of the CIPM MRA, that as of August 31, 2002 the CMI quality system as described in the CMI quality system documentation complies with all the requirements laid down by ISO/IEC 17025:1999 international standard and by the CIPM MRA within the scope of calibration measurement capabilities (CMCs) submitted under the CIPM MRA and specified by the CMC-STD database available at [www.cmi.cz](http://www.cmi.cz).

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