Information for the CCRI (Section II) about the works in the field of radionuclide metrology, carried out at the D.I. Mendeleyev Institute for Metrology within the period of 1999 – 2000.

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1. Within the framework on radionuclide activity measurements and traceability of the radionuclide activity unit in Russia, the Laboretory of Ionizing Radiation has carried out metrological certification of:

- standard spectrometer sources of the type “multigamma” on the basis of the radionuclides ^{133}Ba, ^{134}Cs, ^{152,155}Eu, ^{166m}Ho, ^{192}Ir, ^{207}Bi, ^{220}Ra, ^{288}Th (from ^{232}U);
- radionuclide solutions as activity reference standards on the basis of the radionuclides: ^{3}H, ^{14}C, ^{147}Pm, ^{88}Y, ^{123}I, ^{125}I, ^{238}Pu, ^{239}Pu, ^{226}Ra and other;
- standard spectrometer X-rays sources on the basis of the radionuclides: ^{55}Fe, ^{109}Cd, ^{241}Am, ^{125}I, ^{238}Pu, ^{153}Gd, ^{147}Pm, ^{204}Tl;
- volumetric measures of activity unit on the basis of certified samples of ore materials with the natural content of uranium, thorium and potassium, as well as other measures with various matrix densities and radionuclide compositions;
- a- and ß-spectrometers, radon radiometers, a- and ß-radiation radiometers or the environmental monitoring, which are intended to be used at the calibration laboratories of Russia.

2. Key comparisons.

2.1. The Laboratory of Ionizing Radiation took part in the international key comparisons of the CCRI.

2.1.1. Ampoule ? 8296 with the ^{152}Eu solution was received for activity concentration measurement.

The ^{152}Eu activity in the sources on thin films was measured by the extrapolation method of 4pß-?-coincidences, using an installation with a proportional “pill-box” 4p-counter and a scintillation counter with the 40x40 mm NaI (Tl) crystal.

The sources were made of solution on the thin films gilded from both sides with a total surface density of ~40 µg/cm^2. To improve the uniformity of the activity layer, recrystallization in the NH_4OH atmosphere was applied.

An energy window in the ?-channel was set at the region of 500-1500 keV, that allowed to receive a minimum slope of the extrapolation dependence (˜9%). The maximum efficiency in the ß-channel was 79%, its change was being carried out by super-imposing additional films and foils on the source.

The combined uncertainty of ^{152}Eu activity measurement was 0,40%.

Except for the 4pß-?-coincidence method, the ^{152}Eu activity was measured by a coaxial HP Ge semiconductor detector with the volume of 43,9 cm^3 and resolution of 0,18% on the 1332 keV eine. The efficiency curve was determined using 65 ?-lines from 18 radionuclides with the energy from 59,5 keV (^{241}Am) to 1836 keV (^{88}Y), the activity of which in the sources was measured by absolute methods. The combined uncertainty of method for ^{52}Eu was 0,39%.

2.1.2. The ^{89}Sr activity in the sources on thin films was measured by the absolute 4p-counting method using a proportional 4p-counter. Absorption in the substrate film and in the

source was determined by the sandwich method. The substrate film was treated with insulin before depositing the radionuclide solution, the recrystallization in the H_2S vapour was used to obtain a thin and uniform layer. Special attention was paid to investigations of the dependence of measurement results on the inner diameter of the ring supporting the substrate film. For thin Al rings (100-200 μm) this dependence was not observed.

The ^{85}Sr and ^{90}Sr impurities in the ^{89}Sr were determined using a plastic scintillation spectrometer.

The combined uncertainty of the ^{89}Sr activity concentration measurement was 0,2%.

3. Research projects.

3.1. To carry out a joint project with the LNHB (France) for measuring absolute ?-ray intensities of ^{226}Ra in equilibrium with its decay products, a special technology was developed and a special spectrometric source was designed, in which a point-formed ^{226}Ra compound was placed between two glued thin steel foils was manufactured. The Rn emanation coefficient was less than 0,1%, the ^{226}Ra activity was ~40 kBq.

3.2. Measurements of the ?-ray spectrum of the capsulated ^{153}Gd source with the activity of ~1 Ci, intended for osseous tissue densitometry were carried out. The spectra were measured on the planar Ge-spectrometer calibrated with a set of spectrometric sources. The ratio of the 44 keV photon flux to the flux of the ?-rays group with the energy of 100 keV was 1,81 while for a "weightless" source of ^{153}Gd that ratio is 2,37

3.3. The photon flux was measured and the equivalent ^{235}U mass was calculated for the sources imitating solid mass of metallic uranium, manufactured in the form of cylinders coated with a thin layer of uranium salt. The imitators are intended for calibration of fissile material monitors on checkpoints of enterprises and custom-houses.