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Field of capture gamma radiation with an energy of up to 10 MeV

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The use of dosimeters calibrated in reference fields with corresponding energies for correct estimation of dose loads for personnel working in high-energy gamma-radiation fields with energies above 3 MeV is required. The creation of reference fields with gamma-radiation energies up to 7 MeV is essential for photon radiation dosimetry at nuclear power plants, where a significant gross dose rate component is stipulated by the radiation with an energy of 6.13 MeV associated with the 16O(n, p)16N reaction in the water cooling loop. Apart from nuclear power plants, such tasks occur on electron accelerators, widely used for therapeutic, industrial and other purposes.

The state verification schedule (Republic of Belarus and Russian Federation) stipulates the use of 241Am (0.06 MeV), 137Cs (0.662 MeV) and 60Co (1.250 MeV) radionuclides for reference dosimetry measurements of gamma radiation in the range from 0.06 to 3 MeV. No standard calibration and verification is performed for nuclear physics equipment in bremsstrahlung with an energy above 3 MeV generated by accelerators. Dosimeters calibrated in the radionuclide sources fields may not measure the dose rate from high-energy gamma radiation correctly. At the same time, there is a nomenclature list of instruments with various detector types, where the energy range has to be expanded to 7 MeV or 10 MeV following the relevant research is carried out.

High-energy capture gamma-radiation fields with energies up to 7 MeV (titanium target) and up to 10 MeV (nickel target) to calibrate the energy scale and verify the energy dependence of developed spectrometric and dosimetric measuring instruments were generated by AT140 Neutron calibration facility for radiation monitoring instruments according to the requirements of international standard ISO-4037:2019 [1, 2].

The report presents the results of experimental studies. The standard dosimeter AT5350/1 with a highly sensitive ionization chamber TM32002 was used to determine the air kerma rate and ambient dose equivalent rate of gamma radiation [3].

1. Damian Komar et al. // 2016. Neutron capture gamma ray field with energy to 10 MeV from radionuclide fast neutron source. Devices and Methods of Measurements. 7, 279-285.
2. Damian Komar et al. // 2017. A Source of neutron capture gamma-ray with energy to 7 MeV and to 10 MeV based on Neutron Calibration Facility. Proceedings of the National Academy of Science of Belarus. Physical-technical series. 2, 96-103.
3. Damian Komar et al. // 2017. Metrological support of dosimetry gamma-ray with energy to 10 MeV for radiation protection devices. Devices and Methods of Measurements. 3, 279-285.

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