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Dosimetric Calibration of a Panoramic ^{60}Co Gamma-Ray Source

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Background of the study. The panoramic ^{60}Co source at the Ruđer Bošković Institute is the only irradiation facility in Croatia suitable for variety of applications: from medium range doses used in radiobiology and accident dosimetry to high doses pertaining to radiation processing and research in radiation chemistry. In November 2015 thanks to the IAEA support the source was upgraded with additional 3.5 PBq. The results of precise dosimetric calibration and determination of dose distribution curves typical of the cylindrical gamma ray panoramic source geometry are presented.

Methodology. Because of the cylindrical shape of the source, the radiation field also has a cylindrical symmetry and is best described by cylindrical coordinates. Radiation field mapping was performed with ethanol-chlorobenzene (ECB) dosimetry system which was developed 50 years ago in our Radiation Chemistry and Dosimetry Laboratory and subsequently accepted as an international standard (ISO/ASTM 51538). The commercial 5 cm³ pharmaceutical ampoules were used for irradiations. Irradiated ECB dosimeters were analysed for chloride ion concentration by two methods: oscillometry before opening; after opening aliquots were taken for mercurimetric titration. Oscillometry was performed by an oscillotitrator Model OK-302/1 (Radelkis Electrochemical Instruments, Budapest). After measurements, the doses were evaluated from the previously determined calibration curves. For mercurimetric titration, the standardization of Hg+2 solution used for titration with standard NaCl solutions was performed daily before the analysis of irradiated dosimetric solutions. All doses were expressed as “absorbed dose to water”. For dosimetry calibration and “transit” dose measurements an ionization chamber type 2581 and a Farmer Dosimeter type 2570 (NE Technology Limited, England) were used.

Results. Dose mapping in horizontal and vertical planes was performed with ECB dosimetry system, as follows: (a) The check for the angular symmetry of the radiation field was performed inside the annular space enclosed by the source rack. (b) The dependence of the dose rate D on the radius r from the axis of the cylinder was measured at two heights: at $h = 0$ cm, which is in the horizontal plane passing through the centre of the source cylinder and at $h = 100$ cm. (c) The dependence of dose rate D on the height h was measured at two radii: at $r = 50$ cm from the axis of the source, and at $r = 100$ cm from the axis, both in vertical planes through the axis. The “transit dose” was measured at different radii at $h = 0$.

Conclusion. It was shown that the radiation field of the cylindrical gamma ray panoramic source is fully describable by using only two parameters, radius r from the axis and distance h from the reference horizontal plane.

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Country/Organization invited to participate

Croatia

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