# Flux and Energy Deposition Distribution Studies Inside the Irradiation Room of the Portuguese $^{60}$Co Irradiation Facility

**Luis Portugal*** **and Carlos Oliveira**
*Nuclear and Technological Institute, Radiation Protection and Nuclear Safety Department*
*Estrada Nacional N. 10, Apartado 21, 2686-953 Sacavém, Portugal*

## Abstract

In December 2003 the irradiator of the Portuguese $^{60}$Co irradiation facility, UTR, was replenished. Eighteen new sources were loaded and the older ones (156) were rearranged. The result was an irradiator with about 10.2 PBq of total activity. The active area of the irradiator has also increased. Now it uses twenty five of the thirty tubes of the source rack, nine more than in the previous geometry. This facility was designed mainly for sterilisation of medical devices. However it is also used for the irradiation of other products such as cork stoppers, plastics and a limited number of food and feed.

The purpose of this work is to perform dosimetric studies inside the irradiation room of a $^{60}$Co irradiation facility, particularly, the flux and energy deposition distributions.

The MCNPX code was used for the simulation of the facility. The track average mesh tally capabilities of MCNPX were used to plot the photon flux and energy deposition distributions. This tool provides a fast way for flux and energy deposition mapping.

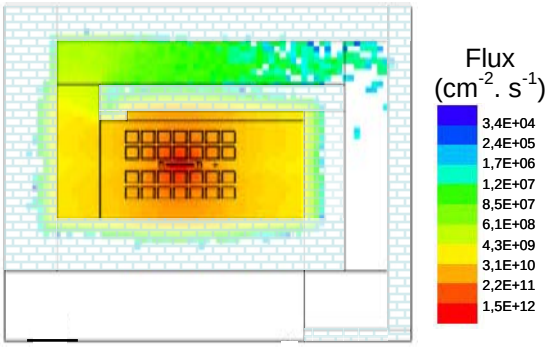
The absorbed dose distribution near the walls of the irradiation room was also calculated. Instead of using meshtallys as before, the average absorbed dose inside boxes lined with the walls was determined and afterwards a plot of its distribution was made. The absorbed dose rates obtained ranged from 5 to 500 Gy.h$^{-1}$ depending on material being irradiated in process and the location on the wall. These positions can be useful for fixed irradiation purposes.

Both dosimetric studies were done considering two different materials being irradiated in the process: cork stoppers and water, materials with quite different densities (0.102 and 1 g.cm-3, respectively). These studies showed some important characteristics of the radiation fields inside the irradiation room, namely its spatial heterogeneity. Tunnelling and shadow effects were enhanced when the product boxes increases its density.

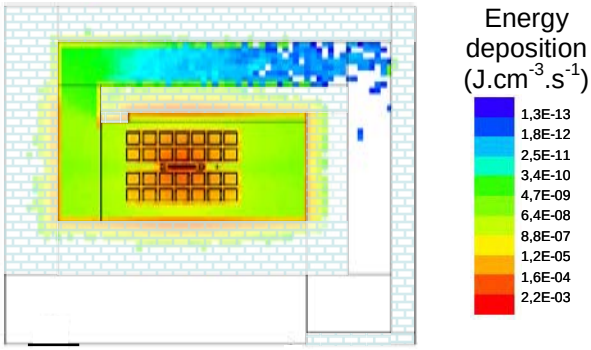
Besides a deeper dosimetric understanding of the irradiation room, these results also indicate that simultaneous irradiation of products in fixed positions is possible and with good dose rates.

***KEYWORDS: MCNPX; Dosimetry; $^{60}$Co irradiation facility; Absorbed dose.***

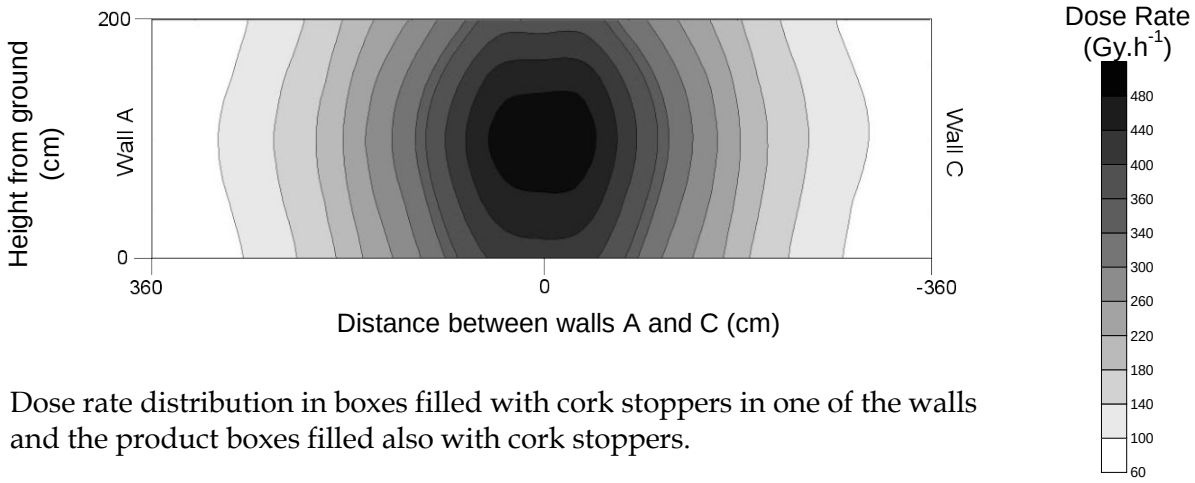
* Presenting author, E-mail: portugal@itn.pt



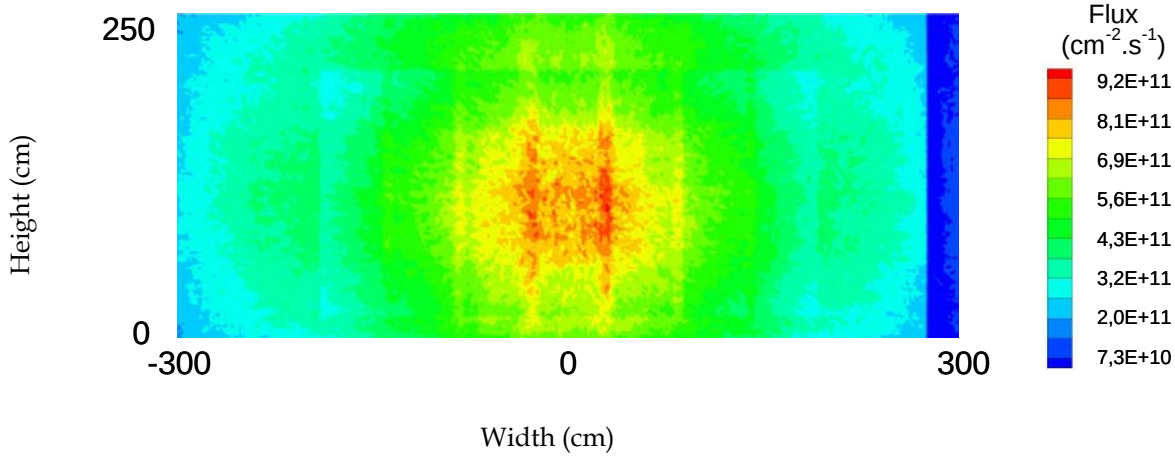

Photon flux on the irradiation room at 133 cm height and the product boxes filled with cork stoppers.




Energy deposition on the irradiation room at 133 cm height and the product boxes filled with cork stoppers.




Dose rate distribution in boxes filled with cork stoppers in one of the walls and the product boxes filled also with cork stoppers.




Mapping of the photon flux distribution between the wall and the first row of hangars.