Gamma dose from building material: an improved room model, robustness of RP112 index I and radiation protection consequences

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In the last 30 years building materials have been studied as the most important source of indoor gamma ray exposure for the population. Research activities have been mainly devoted to developing computational methodologies - room models - and *in situ* techniques [1] to evaluate and predict the indoor gamma dose rate on the basis of the radioactivity and other characteristics of building materials. We have compared several room models published in the international literature, and verified their substantial equivalence. In addition, we studied the robustness of the *Markkanen room model* - the model chosen by the European Union to provide indications for limiting the use of certain building materials [2] - and also improved it with a larger energy line analysis. Starting from this model we set up an integrated method which, tested in several real situations, has given quite satisfactory results. At the same time, a wide activity of inventory of building material radioactivity content has been carried out at the national and European levels [3], to support the evaluation of the impact of this gamma ray source on population exposure. The database allowed us to calculate the activity concentration index *I* - suggested by a European technical guidance document and recently adopted in the draft Euratom Basic Safety Standards Directive - for many building materials in the European Union and to discuss possible implications on the choice of different parameters in the model, that is type of floor and ceiling, background to be subtracted, dose criteria, etc. Moreover, with the data collected an independent assessment of gamma doses was made in a model room, making reasonable hypotheses on the use of materials. Finally, a comparison of the two approaches, i.e. index *I* and room model, was carried out.

1. Nuccetelli C. *In situ* gamma spectroscopy in environmental research and monitoring. Appl Radiat Isot. 2008 Nov;66(11):1615-8.
2. Risica S., Bolzan C., Nuccetelli C. (2001). Radioactivity in building materials: room model analysis and experimental methods. The Science of the Total Environment, 272: 119-126.
3. Trevisi R., D'Alessandro M., Nuccetelli C., Risica S. Radioactivity in Building Materials: a first Overview of the European Situation. Proceedings of the IRPA 12 Conference, BBuenos Aires, October 20 – 24, 2008. STI/PUB/1460 (ISBN 978-92-0-105410-4). TS III.4.4, 3464.