Session 4: NORM in building materials

x **Oral presentation**

Modelling of radiation doses arisen from the use of phosphogypsum-made bricks in construction

Marcelo F. Máduar; Barbara P. Mazzilli; Marcelo B. Nisti

Instituto de Pesquisas Energéticas e Nucleares, São Paulo, Brazil

Problem formulation

Phosphogypsum (PG), a by-product from the fertilizers industry, can contain natural radionuclides in significant concentrations. Radiation dose assessment by using Ra-equivalent and gamma indices is usual in the evaluation of effects of NORM materials present in constitutive elements of buildings. The use of such indices provides a simple and effective way to obtain screening values, provided the radioactivity contents in the building materials are known. However, for a thorough evaluation, accurate forecasting of doses indoors can only be performed by using computer codes for transport of radiation inside matter, suited for the elemental composition and geometry of the building.

Methods

In order to evaluate the feasibility of using PG in the manufacturing of building elements such as bricks and plates, GEANT4, a Monte Carlo code by CERN for radiation-matter interaction, was applied in the present work. The scenario considers walls built with PG bricks prototypes already developed, in a realistic way as detailed as possible. Natural gamma-emitter radionuclides with homogeneous distribution within the bricks are assumed to exist.

In this work, a case study is performed, using the physical parameters of the prototype bricks, including elemental composition, apparent density and geometry details. The radioactive contents in Brazilian phosphogypsum from different origins, already characterized in previous works, was applied in the simulations of the present work, including radionuclides concentrations from the radioactive decay chains of uranium and thorium, and for ^{40}K.

Conclusion

Spatial dose distributions indoors were performed for several brick assemblies, showing that the dose indoors vary along the internal volume of the compartment. We conclude that this application of GEANT4 code can be successfully applied in evaluation of dose indoors arising from NORM present in the building structure, by incorporating geometry details that can vary between exposure scenarios.