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## On the feasibility of dating the age of a nuclear incidental event by gamma-ray spectrometry of environmental samples

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The dating of a nuclear incidental event is an important element for the assessment of its environmental impact and radiation protection implications on the involved population. In this framework, a procedure has already been proposed to determine the age of a nuclear event by measuring through a gamma-ray spectrometric analysis the activity of two fission products in a small sample of uranium irradiated for a short time in a nuclear reactor [1,2]. However, It may be useful to extend the application of the above mentioned procedure for assessing the “timing of occurrence” of an incidental event considering other samples and in particular, by sampling and measuring environmental samples.

The aim of this work was to verify the feasibility of the dating procedure utilizing gamma-ray spectrometric measurements of environmental samples on various matrices as well as the applicability to cases where there are not enough information regarding sample characterization (as composition, sample density, measurement geometry, calibration parameters of the measurement system and so on).

The procedure, which involves the temporal analysis of the data of several measurements taken on a sample with increasing waiting times, was tested taking into account the results of the measurements related to the first irradiation of an UO<sub>2</sub> fuel pellet in the Research Nuclear Reactor AGN 201 “COSTANZA”, supplied with the University of Palermo, as well as those related to radioactive contamination following various nuclear events, as the Chernobyl or Fukushima accidents.

The analysis of the values of the activity ratios for different radionuclides (isotopes, isobars, etc.) has led to extremely comforting temporal results in the case in which the system can be considered isolated, for the irradiation modalities or its temporal evolution. More uncertainties characterize the evaluations related to samples of different origin and nature, in which the quantities may have been relatively modified due to the physical-chemical phenomena that have affected the reference matrices.

In conclusion, the method is largely applicable but attention must be paid to possible uncertainties caused by probable chemical-physical changes that may occur in a no-insulated sample originating from distant sites.

### References

- [1] – Nir-El Y., Applied Radiation and Isotopes, 60 (2004), 197-201.
- [2] – Nir-El Y., Journal of Radioanalytical and Nuclear Chemistry, 267 (2006), 567-573.