Simulation of fire in a deposit of radioactive waste and the radiological risk associated to this scenario

E. N., Domingos[1], L. A., Aguiar[2], Z. R., Lima[1]
e-mail: erica.ndomingos@gmail.com, laguiars@ird.gov.br , zrlima@ien.gov.br

[1] *PPGIEN, IEN*
[2] *IRD*

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According to the norm CNEN 8.01, some wastes have conditions that allow their release as conventional waste and these must be strictly obey. Radioactive waste that do not conform to these standard conditions or in other words, they are above the exemption limit, should be stored safely so as not to affect occupationally exposed individuals as well as individuals of the public and the environment.
The purpose of this study is to simulate the fire in a radioactive waste deposit, to provide estimates of the dose in which people will be submitted, to assist in making decisions and minimize the possible consequences.
Fire modeling and the effective equivalent dose were performing in Hotspot Health Physics Codes 3.0.3 software. The fire model in the hotspot considers the physical height of the explosion, the radius of release, which in the present study were admitted values of 2 and 1 meters, respectively, and also considers the height of the cloud generated by the explosion of 10 meters. It was considered a mixture containing several radionuclides, as shown in Table 1.

Table 1 - Radionuclide and the activity involved

Radionuclide	Activity (Bq)
^{241}Am	1.9×10^{12}
^{59}Fe	3.7×10^{10}
^{60}Co	1.9×10^{12}
^{95}Zr	1.5×10^{10}
^{54}Mn	3.7×10^{10}
^{63}Ni	2.0×10^{10}
^{65}Zn	3.7×10^{10}
^{90}Sr	4.5×10^{8}
^{137}Cs	5.1×10^{10}

The Hotspot provides an estimate of the total effective equivalent dose (TEDE) for the population involved in the scenario of release of radioactive material, in which case the maximum reached 0.029 Sv. The use of TEDE allows comparisons of exposures to different types and levels of radiation. The simulation output data in the Hotspot was used as input data for analysis of the risk of solid cancer in the respiratory system. This analysis was perform using the BEIR V (Biological Effects of Ionizing Radiations) model, a linear relative risk model obtained by adjustments of the LSS (Life Span Study) as presented in the [1].
To calculate the radiological risk in the respiratory system, the doses received by the lung were estimated in relation to the distance of the source event, ranging from 10 m to 2 km. From the lung dose, the following results were found for the relative risk of radiation-induced cancer according to the BEIR V model at 20, 30, 40 and 50 years after exposure, where the relative risk for men and Figure 1, the relative risk for woman, Figure 2.

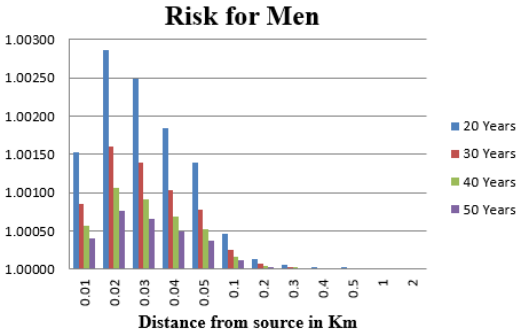

Figure 1. Relative risk of cancer induced.

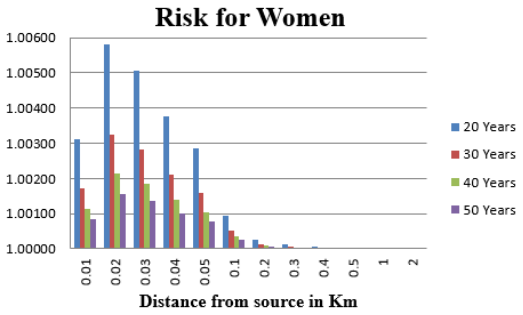

Figure 2. Relative risk of cancer induced.

According to the BEIR V model the relative risk is higher among women because of their large numbers of lower basal rates than men. You may also notice decreased risk with the passage of years after exposure.
In future work the intention is to associate the variation of the duration of the fire with the radiological risk presented in the scenario.

Reference

[1] INTERNATIONAL ATOMIC ENERGY AGENCY. **Methods for Estimating the Probability of Cancer from Occupacional Radiation Exposure**. Vienna: IAEA, 1996. 56p.