Modelling the Contribution of ^{40}K, ^{232}Th and ^{226}Ra to Radiation Dose and Risk from Airborne Discharges of Coal-Fired Power Plants

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Coal contains trace elements and naturally occurring radionuclides such as ^{40}K, ^{232}Th, ^{238}U. When coal is burned, minerals, including most of the radionuclides, do not burn and concentrate in the ash several times in comparison with their content in coal. Usually, a small fraction of the fly ash produced (2-5%) is released into the atmosphere.

The activities released depend on many factors (concentration in coal, ash content and inorganic matter of the coal, combustion temperature, ratio between bottom and fly ash, filtering system). Therefore, marked differences should be expected between the by-products produced and the amount of activity discharged (per unit of energy produced) from different coal-fired power plants. In fact, the effects of these releases on the environment due to ground deposition have been received some attention but the results from these studies are not unanimous and cannot be understood as a generic conclusion for all coal-fired power plants.

In this study, the dispersion modelling of natural radionuclides was carried out to assess the impact of continuous atmospheric releases from a selected coal plant. The natural radioactivity of the coal and the fly ash were measured and the dispersion was modelled by a Gaussian plume estimating the activity concentration at different heights up to a distance of 20 km in several wind directions.

External and internal doses (inhalation and ingestion) and the resulting risk were calculated for the population living within 20 km from the coal plant. In average, the effective dose is lower than the ICRP's limit and the risk is lower than the U.S. EPA's limit. Therefore, in this situation, the considered exposure does not pose any risk. However, when considering the dispersion in the prevailing wind direction, these values are significant due to an increase of ^{232}Th and ^{226}Ra concentrations in 75% and 44%, respectively.