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**Assessment of the Exposure of the Israeli Public to Ionizing
Radiation from Natural Sources**

L. Epstein^{1,2,*}, J. Koch¹, T. Riemer¹, I. Orion² and G. Haquin¹

¹Radiation Safety Division, Soreq Nuclear Research Center, Yavne

²Department of Nuclear Engineering, Ben-Gurion University of the Negev, Beer-Sheva

Abstract

Natural sources account for the greatest part of the exposure to ionizing radiation for most individuals. Natural sources have two origins: natural radionuclides in the earth's crust and cosmic radiation. The goal of this study was to assess the average radiation dose from natural sources to the population of Israel, taking into account local characteristics (geology, geography) as well as specific features of the local lifestyle.

The building industry in Israel has a few distinctive characteristics: almost all buildings are made of concrete or concrete blocks and since 1985 building materials, such as fly ash, in which concentrations of natural radionuclides are higher than in other building materials are being widely used. Another characteristic of buildings built since the early 1990's is a shielded area built in every apartment that is known as a DSS (Dwelling Shielded Space). The DSS is a room built from thick concrete walls and ceiling that can be hermetically sealed and is intended to protect its residents from a missile attack. In many apartments the DSS is used as a bedroom.

In order to assess the average indoor radon concentration, results of a 2006 radon survey in single-family houses were combined with results from a radon survey performed in the present study in apartments of multistory buildings. The survey in multistory buildings assessed the combined influence of the DSS and the use of building materials that have higher concentrations of natural radionuclides on the radon concentration by dividing the dwellings into two groups: apartments in buildings older than 20 years, that do not include the above mentioned building characteristics, and apartments in buildings newer than 10 years, that do include them. Another feature that could cause higher radon concentrations inside new buildings is the better sealing of doors and windows achieved using new building techniques. It was found that the average radon concentration in new buildings ($41.9 \text{ Bq}\cdot\text{m}^{-3}$) is significantly higher than its concentration in old buildings ($22.9 \text{ Bq}\cdot\text{m}^{-3}$). The average radon concentration inside Israeli dwellings was calculated according to the distribution of apartment types (single-family houses, apartments in new and in old multistory buildings) and was found to be $31.1 \text{ Bq}\cdot\text{m}^{-3}$. The average dose due to radon inhalation was estimated to be 1.2 mSv, based on the updated information included in the 2009 ICRP Statement on Radon.

The dose rate inside buildings was assessed using a model that takes into account the concentrations of natural radionuclides in the building materials, the dimensions of the room and the density and thickness of the walls. The dose rates above different geological units in Israel, as measured by the aerial survey conducted in 1998, were

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used to calculate the average dose rate outdoors. The average dose rate inside buildings was found to be 25 nSv·h⁻¹, approximately 1.3 times the average dose rate outdoors (20 nSv·h⁻¹).

In addition, the internal exposure due to food and water consumption was estimated and the distribution of the annual dose from cosmic radiation was assessed.

The average annual dose to the population of Israel from all natural sources is equal to 2.0 mSv, while the range of values extends from 1.7 mSv to 2.7 mSv.