Abstract

Design for Measurements of Environmental Radon Using TLDs

by
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Lawrence Livermore National Laboratory (LLNL) has measured and reported gamma radiation at the Livermore Site perimeter since 1973. Gamma radiation results from natural background sources of geologic/terrestrial or cosmic origin, man-made sources such as fallout from past nuclear weapons testing, and contribution from LLNL operations. Direct gamma radiation data using thermoluminescent dosimeters (TLDs) and gross beta measurements from high-volume air particulate samplers, collected over the past twenty years, show elevated levels during the fall quarter of each year.

We hypothesize that such seasonal variation is due to elevated airborne radon concentrations caused by seasonal meteorological and related geological conditions. A test of this hypothesis will be conducted by measuring radon indirectly with a TLD-holding device located inside of a lead cave that shields out all gamma radiation except for that from radon daughter products and cosmic radiation. The sampling device consists of two modules: 1) suction equipment to continuously pass the air that is being investigated through a sampling head and equipment to keep the air flow constant; and 2) a sampling head with a particulate filter to collect the radon daughter products contained in the air flow and two TLDs with an aluminum shield between them. The aluminum shield provides for the discrimination of energy and radiation. Another TLD is placed inside the lead cave to solely measure cosmic radiation. Track-etch detectors will also be placed at each sampling location to monitor the radon directly.

Calcium fluoride (CaF) TLD chips are used in the sampling head for measurements because they are of acceptable sensitivity. However, since these TLDs are known to have significant fading, a correction factor will be applied to the data. The filter from the sampling device will be analyzed for gross beta activity by a proportional counter and for gamma activity by spectroscopy; these data will be analyzed with the TLD results, the track-etch measurements, barometric pressure, soil moisture, and other relevant meteorological parameters. This analysis will be examined for correlation to determine causes for the seasonal effects which impact the results from the routine environmental monitoring TLDs.

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