Project Title: Measurement and Apportionment of Radon Source Terms for Modeling Indoor Environments

Organization: NYU Medical Center
Department of Environmental Medicine
550 First Avenue
New York, NY 10016

DOE/ER/60547--1

DE91 000823

Principal Investigator: Naomi H. Harley

Research Objectives

This research has two main goals; (1) to quantify mechanisms for radon entry into homes of different types and to determine the fraction of indoor radon attributable to each source and (2) to model and calculate the dose (and therefore alpha particle fluence) to cells in the human and animal tracheobronchial tree that is pertinent to induction of bronchogenic carcinoma from inhaled radon daughters.

Accomplishments During 1990-1991

a. Research House Activities

a. 1. Radon Flow from Indoor/Outdoor Pressure Differences

During 1990 emphasis was placed on the analysis of variability of pressure driven flow into the ultra-high energy efficient research home in northern New Jersey. A cross-slab basement pressure sensor was installed and hourly data are collected on a portable computer with an average of about 30 pressure samplings per hour.

The regression of hourly radon and pressure data show a weak relationship but the weekly averages of hourly data indicate a reasonably good relationship (Figure 1). The regression of indoor-outdoor temperature difference with cross-slab pressure difference indicates that temperature difference is the primary mechanism (Figure 2) as is generally recognized. However, the regression is the reverse from that expected, i.e., a greater negative pressure produces dramatically decreased indoor radon. Reduced pressure inside the dwelling compared with outside brings soil radon into the dwelling, however, this generality has not yet been well supported with data to study exact mechanisms.

These data were presented at the annual Health Physics Society meeting in June 1990.

To study reasons for the overall radon variability with pressure differential we investigated whether radon in water might be a significant factor. This home has a private well and it is not unusual for ground water to be a contributor to indoor

radon. The conventional factor to relate radon concentration in water to the average value in air is 10000/1. However, this factor has not been studied in detail to date.

One liter samples of tap water were taken at the research home in the early morning and counted in the whole body counter at NYU Medical Center within 4 hours. Preliminary results on water samples taken on 4 consecutive weeks indicate a concentration of about 40 kBq/L (10,000 pCi/L). Water is used most intensely by 2 adults and 3 children in the morning and evening. Duplicate passive radon monitors of our own design utilizing CR-39 SSNTD material were placed in the upstairs bath. These have been in place for only 2 weeks and we await the first data points.

a. 2. publication of Apartment Data

Three years of hourly radon measurements in a high-rise apartment were summarized and submitted to the journal Health Physics. These data were collected in a pilot study to test the radon monitors which were developed under the DOE contract several years ago. The monitors are the only "radon only" monitor currently available. They utilize an electret to collect the decay products at formation, leaving the detector volume virtually free of interference from the daughters. Radon in the detector volume is counted for the measurement. The calibration factor is 170 cph/pCi l^{-1} and the background 8 cph. Even outdoor concentrations are easily measured with these units.

Hourly indoor and outdoor data were reduced to weekly averages for presentation. The radon concentration in the apartment studied was only 50% higher than the measured outdoor radon concentration over a three year period. All of the published literature on concentrations in apartments was summarized as well. Little interest has been expressed in low concentrations of radon because it is the high concentrations that confer substantial individual risk. However, it is of interest to understand the overall distribution of radon exposure to know the total population risk. About 40% of the U.S. population is exposed to near outdoor levels as a consequence of living in apartments.

a. 3. Quality Assurance

A radon counter which acomodates measurement of a 1.7 liter flask was constructed in house for the purpose of quality coantrol measurements. Samples of indoor air (grab samples) are taken weekly with the flasks and counted in the QC counter for comparison with the data from the continuous radon detectors. Grab samples are taken weekly in the old-style research house and several times per year in the ultra-high energy efficient home. This insures the measurement quality of our data base. These same flasks are used in the EML radon intercomparison exercise. The most recent intercomparison (April 1990) was run at about 6 pCi/L. Our measured value was 1.05 of the EML true value.

b. Dosimetry

During this year time was spent assisting Dr. Edith Robbins in the morphometric analysis of human bronchial cells.

It is important to document the details concerning the patient's life style, such as smoking, occupational, residential, family and dietary history. This will assist in the analysis when data are fully tabulated. This PI reviews the clinical charts for details and conducts a patient interview with essentially every patient in the data base.

The cell depths for the preliminary base are being coded by hand into a PC. Although this may be part of the stereological program at a later time, it is not unreasonable initially to obtain a good working knowledge of the details of the input data. This has led to improved data handling with this growing data base.

Proposed Work in Research Homes

We propose to concentrate on the mechanisms for the negative correlation of indoor radon and cross-slab pressure. Part of the indoor source is now thought to be radon in water. We propose to study the radon in water variability with weekly tap water samples. The variability in air due to water use will be measured by obtaining average concentrations in the bath determined with NYU passive monitors. These averages will be compared with the hourly data from continuous monitors located in the basement and top floor. This study can better quantitate the relationship between radon in water and radon in air which is a factor of some importance at the present time.

A substantial data set showing the effect of radon in water on indoor concentrations will be of value to the Radon Research Program. Guidelines for radon in water are currently being formulated by EPA without an in depth study of variability in water radon concentration, seasonal differences and the apportionment of this source to total indoor radon.

The negative correlation of indoor radon and pressure differential across the slab is significant. We thought initially that this was the result of fresh air brought under the dwelling by the negative pressure. This home is built with a 6" layer of crushed rock and 2 layers of heavy gauge polyethylene sheet under the basement slab. Air flow under the slab as air is drawn into the home is unavoidable.

Straightforward calculation shows that this is not the case, however. As airflow under the house increases, more air is brought into the home but at lower radon concentration. As the flow rate decreases less air is brought into the home but at higher concentration. These two flow conditions should

DISCLAIMER

-END-

DATE FILMED

11 / 1 / 90