Project ID: **59882**

Project Title: **Measurements of Radon, Thoron, Isotopic Uranium and Thorium to Determine Occupational & Environmental Exposure & Risk at Fernald Feed Materials Production Center**

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Research Objectives:

1. To develop an accurate personal ^{222}Rn (radon) and ^{220}Rn (thoron) monitor to measure an individual exposures during DOE remediation activities.

2. To develop a personal aerosol particle size sampler, based on the principles of a novel sampler we have developed. The sampler measures not only ^{222}Rn decay product aerosol size but long lived nuclides, size distribution and air concentration. As yet, there are no personal size distribution data for the inhaled aerosol particle size distribution of any radioactive nuclide during DOE remediation activities, yet the aerosol particle size is the major determinant of the radiation dose to the lung.

3. To develop the sequential radiochemistry necessary to measure any environmental sample for the isotopes of uranium, thorium, radium and lead-210. To utilize this radiochemistry for lead-210 before and after the radium is removed form the silos to accurately determine the amount of radon gas released, from the parent radium during removal. To utilize the radiochemistry to accurately trace and delineate thorium, radium and uranium nuclides, originating from Fernald, in the environment.

Research Progress and Implications

1. As of June 1999, the personal ^{222}Rn (radon, t1/2= 3.8 days) and ^{220}Rn (thoron, t1/2 = 55 sec) badge monitor has now been used at Fernald for several months. It is small, lightweight and shaped like a cloverleaf. It clips onto a collar or lapel with a standard badge clip. It has 3 monitoring chambers, for passive solid state, nuclear track, alpha particle detection film. One chamber measures the total gas signal. A diffusion barrier at the entrance of both of the other chambers prevents thoron gas entry, and these chambers measure only radon. The thoron concentration is obtained by signal difference.

This is the only personal passive radon and thoron monitor in use at a DOE facility.

2. As of June 1999, we have now had two miniature particle size samplers at Fernald for up to 10 months. It is presently in use as a field unit between the 2 radium silos, and indoors where radon exposure is elevated. The field units are using a miniature 110 volt pump to operate, however, it can also be used as a personal particle size sampler, and clipped onto a collar or lapel. A small, standard battery operated pump, clipped to the belt, is then used to operate the sampler. The particle size sampler uses a commercial sampler aluminum case, modified to have six sample filtration stages. There is an entrance impaction stage, capturing all particles greater than 2 micrometers diameter, followed by four fine mesh screen filters to collect very small particles, and a backup filter to capture all exiting particles. The size distribution is calculated using an extreme value estimation deconvolution program. The filters and screens are alpha counted using our high efficiency (50%), low background (5 count per day) alpha counters that were designed in house.

No other DOE project, measures personal particle size distribution data, as well as air concentration, for inhaled material, yet it is the particle size that determines the radiation dose to the lung. This device should have wide application at other DOE sites for a variety of pollutants.

3. As of June 1999, Dr. Isabel Fisenne, at the USDOE Environmental Measurements Laboratory (EML), collaborating on the project, has developed a sequential radiochemical procedure to analyze any environmental sample matrix, presently focused on soil samples, for lead-210, radium, thorium, and uranium isotopes.

Planned Activities

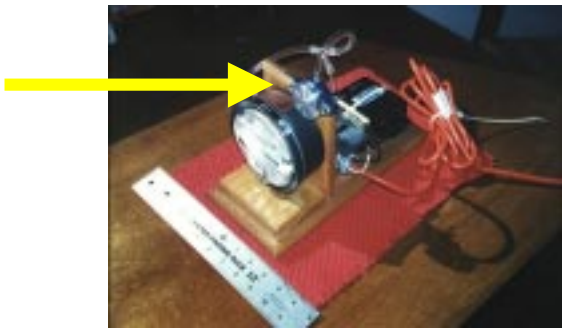
1. The personal radon and thoron monitors will be used exclusively for personal monitoring during all cleanup activities at Fernald. We now have an inventory of 200 monitors that will be used on all potentially exposed personnel.

2. Several additional particle size samplers are to be deployed on site at Fernald. One additional field instrument was sent in June 1999, and will be placed near the raffinate pits nearing cleanup. This will provide background information on air concentrations and particle size. The cleanup of these pits will generate airborne particulates containing thorium and other nuclides. These particle size samplers will be used both as personal samplers and field samplers to provide the only existing data on personal and field particle size distribution and air concentrations of radioactive particulates.

3. The radiochemical procedure developed by Dr. Fisenne at the USDOE, EML is to be used to analyze soil samples taken before and subsequent to the removal of the K-65 radium sand in the 2 silos. A fraction of the radon gas released during the radium removal will decay to ^{210}Pb and deposit on the soil surface. In this way, it is possible to estimate accurately the radon that is released during removal of the material in the silos.

Information Access

The data, obtained at Fernald, using both the personal radon and thoron monitor, and the particle size sampler, will be presented at the annual Health Physics meeting in Philadelphia, June 1999. The extended abstracts for both presentations are available in Health Physics 76; 163, 1999. A web page will report all data as it is obtained (charlotte.med.nyu.edu/faculty/harley.html)



Personal Radon and Thoron Monitor

Personal Particle Size Sampler