Project Title: Measurement of Radon, Thoron, Isotopic Uranium and Thorium to Determine Occupational and Environmental Exposure and Risk at Fernald Feed Material Production Center
Publication Date: September 25, 2001

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PROGRESS REPORT

Research Objectives:
1. To develop an accurate personal radon/thoron monitor to quantitate exposure to low airborne concentrations before and during removal and relocation of radium from the silos.

2. To develop a personal aerosol particle size sampler, based on the principles of the novel sampler we have developed. The sampler measures not only ^{222}Rn decay product aerosol size but long lived nuclides. There are, as yet, no particle size distribution data on the aerosol particle size distribution of these nuclides during remediation at any DOE site, although the aerosol particle size is the major determinant of lung dose.

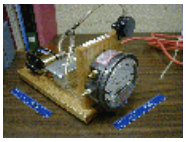
3. To develop the sequential radiochemistry necessary to measure any environmental sample for ^{228,230,232}Th, ^{226,228}Ra, ^{234,235,238}U and ^{210}Pb. To utilize the radiochemistry and accurately trace and delineate these nuclides in the environment. To obtain historic and present radiochemical data to determine the need for supplemental soil/water etc., measurements.

RESEARCH PROGRESS AND IMPLICATIONS
Radon (^{222}Rn) and Thoron (^{220}Rn) Measurement

In 1998 background research was conducted to produce a pilot version of the passive radon, thoron gas detector. A commercial molding company fabricated the pilot units in 1999. The pilot detector contained 3 separate entry ports for 3 alpha track films. Each port contained a specific gas diffusion barrier, allowing separation of the 2 radon isotopes by their half life. Radon was measured in duplicate chambers and the total signal (radon plus thoron) in the third chamber. The radon versus thoron gas concentration is obtained by signal difference.

In 1999, the pilot detectors were first deployed at Fernald inside buildings and on top of the radium silos. In 1999 it was clear that thoron is ubiquitous and there was a need for high quality thoron measurements as well, to be able to specify the precision in both radon and thoron data. Thoron gas contributes to the alpha particle radiation signal in all environments and is a confounder in radon measurements as it contributes to the measurement signal but contributes little to the lung dose . In 2001, the pilot version was modified to incorporate 4 detection chambers, i.e., duplicate radon and duplicate thoron detection. These detectors were fabricated in

June 2001. As of June 2001 there are 25 of the radon, thoron detectors located in buildings and outdoors at the Fernald site, another 25 detectors are ringed around the radium silos, and one detector is on top of the silos. The measurements are obtained at approximately quarterly intervals. Detectors are located at 3 remote quality control locations, two in New Jersey, and one at the National Weather Service site in Manhattan.



Atmospheric Particle Size Detection

Beginning in June 1998, we performed research to develop an instrument for the field measurement of the atmospheric particle size distribution of inhaled aerosols. An instrument package was built using as input a modified commercial personal aerosol particle air sampling probe. The modified sampling probe contains 6 internal filtration stages. The first unit was deployed at Fernald in 1998. Six of these instruments are now deployed at Fernald, and 4 in remote quality control locations. Three are in New Jersey, and one at the USDOE, EML Laboratory in New York City. No other site is acquiring particle size information for inhaled aerosols, although it is the size distribution that determines the actual lung deposition and lung dose. The integrated aerosol particle size distribution is obtained at approximate 2 month intervals at all locations.

Planned Activities

The radon thoron measurements to date are background measurements prior to the removal and eventual transport of the radium to a repository in Utah. As radium is transferred to holding tanks, the radon, thoron release data in 2001 to 2002 will be used to model the distribution and transport of the gas in the environment.

An inexpensive sampler probe of our design is being fabricated commercially for general use at DOE sites in 2002. The sampler can be used for any particulate airborne material by changing the detection method. We currently use ultra low alpha particle detectors to measure radioactivity. The inhaled particle size distribution data will be used in a bronchial lung dose model to realistically calculate the occupational or offsite dose at Fernald to individuals subsequent to the remediation.

Radiochemistry will proceed as soil samples become available.

Information Access

Additional information concerning the radon measurements may be seen at, http://niem.med.nyu.edu/faculty/harleyN.html

Optional Proprietary Information

NYU School of Medicine has applied for a patent (June 2001) for the radon thoron detector.