



Project Summary

Soil and Fill Laboratory Support—1992, Radiological Analyses, Florida Radon Research Program

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The report gives results of radiological analyses of soil and fill samples and data interpretations by the University of Florida in support of the Florida Radon Research Program (FRRP). Moisture, radium-226, and radon emanation coefficient determinations were performed on samples collected and submitted during 1992 by the FRRP New House Evaluation Program (NHEP) and the FRRP Research House Program. During this period, 164 samples representing 31 sites were received and analyzed; this provided a 1991-92 cumulative of 288 samples from 75 sites. Since much of the 1992 sampling represented a continuation of work performed in 1991, the cumulative 1991-92 data were analyzed.

The North Florida NHEP sites (Gainesville vicinity) were characterized by fill with almost exclusively low radium-226 content (<1 pCi/g). Of the 41 sites sampled in 1991-92, the radium content of the first 0.9 m of the substrate was <1 pCi/g at 76% of the sites, 1-10 pCi/g at 22%, and in excess of 10 pCi/g (12 pCi/g) at one site. In 1992, the sampling depth was increased to include a profile to 1.8 m. The range of results was comparable for the first and second 0.9 m depths, but the distribution shifted toward higher values (more sites exceeding 2 pCi/g) for the deeper increment.

For the Central Florida NHEP sites of both years, most of the fill samples and a high percentage of the native soil sites (70-75%) had radium con-

centrations exceeding 1 pCi/g. These sites are characterized by elevated radioactivity (1 to >10 pCi/g) fill over a wide range of substrate concentrations (<1 to >10 pCi/g).

This work supports conclusions from previous years. A large portion of the fill used in Florida construction is of a low radium content. However, elevated radium concentrations do occur in soil at some Florida construction sites, and fill with elevated radioactivity may be an issue in selected circumstances. The extent and source of elevated radioactivity fills should be investigated further and building code development should continue to consider a soil/fill radioactivity standard. At some locations (for example, North Florida) near-surface soil gas radon may originate from deeper than 1 m, and thus shallow soil samples may not be adequate for identifying radon potential.

With respect to the research houses and test modules, these laboratory analyses verified that the sites and test fills are generally representative of the conditions observed at the NHEP construction sites in the respective regions.

This Project Summary was developed by the National Risk Management Research Laboratory's Air Pollution Prevention and Control Division, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

The report gives results of soil and fill analyses performed by the University of Florida in support of the Florida Radon Research Program (FRRP). Radiological characteristics were determined on samples collected during 1992 by the Research House Program and the New House Evaluation Program (NHEP) of the FRRP.

This work is a continuation of efforts to characterize the radon¹ source potential of Florida soil and fill materials. In 1989, a survey of 35 sites distributed statewide examined fill materials at construction sites (66.6%) and native surficial soil at construction or existing house sites (33.3%). In addition, insitu permeability and soil gas radon measurements were performed at a subset of these sites. Work in 1990 emphasized insitu permeability and soil gas radon measurement and soil sampling at 23 statewide sites as prepared for construction. In 1991, the research contractors for the NHEP program submitted samples collected at 42 construction sites in areas of suspected elevated radon potential in North Florida (Alachua County) and Central Florida (primarily Polk County). Samples were also received from the Alachua County and Polk County FRRP Research House sites.

The work in 1992 involved continued support of the FRRP NHEP and Research House projects and analysis of the 1991-92 cumulative data.

Methodology

Samples were collected to represent both the sub-slab fill material and the upper (1-2 m) portion of the underlying substrate. In the laboratory, soil samples were dried and portions were sealed in a container, counted with high resolution gamma-ray spectrometry shortly after sealing, held for ingrowth of radon and its short-lived decay products, and counted at least one more time. Radium concentrations and radon emanation coefficients were calculated from the activity associated with 295.2-, 351.9-, and 609.3-keV peaks of the short-lived radon daughters. The radium concentration was based on the projected equilibrium radon-222 activity; radon emanation coefficient was determined from the pair of values corresponding to pre-ingrowth and equilibrium radon concentrations.

Sample collection methods for the Research House Project are specified in a separate Florida research houses guidance document.

Results and Discussion

During 1992, 164 samples representing 31 sites were received and processed; this provided a 1991-92 cumulative of 288 samples from 75 sites.

Radiological Characteristics at NHEP Sites

The North Florida NHEP sites (Gainesville vicinity) were characterized by fill with almost exclusively low radium-226 content (<1 pCi/g) over predominantly low activity near-surface substrate. Fill samples had concentrations of <1 pCi/g at 30 of 31 sites. At one site, moderately elevated radioactivity fill (3 pCi/g) was found over low activity (<1 pCi/g) surficial substrate. Compared to the 1991 sites, the 1992 sites had a greater percentage of slightly to moderately elevated radium concentrations (1-10 pCi/g) in the first 0.9 m. For the upper 0.9 m of the 41 sites sampled in 1991-92, 76% had <1 pCi/g, 22% had 1 - 10 pCi/g, and only one site exceeded 10 pCi/g (12 pCi/g). Because it appeared that the radon gas was originating from deeper than the 0.9 m sampled in 1991, profiles to 1.8 m were collected in 1992. The range of results was comparable for the first and second 0.9 m depths, but the distribution shifted toward higher values (more sites exceeding 2 pCi/g) for the deeper increment.

For the Central Florida NHEP sites of both years, most of the fill samples and a high percentage of the native soil sites (70-75%) had radium concentrations exceeding 1 pCi/g. These sites are characterized by elevated radioactivity (1 to >10 pCi/g) fill over a wide range of substrate concentrations (<1 to >10 pCi/g).

Radiological Characteristics at Research House Sites

At the North Florida Research House, radium concentrations in the first 1.8 m for two different cores near the house were in the range of 4-7 pCi/g. These values are moderately elevated and indicate that the radon source is near the surface with a relatively uniform distribution at this site. This compares to the several North Florida NHEP house sites that had elevated radium in the near-surface substrate. The sub-slab material from the suction pit was much lower in radioactivity and presumably represents fill. The general material excavated from the pit had concentrations on the order of only

0.3-0.4 pCi/g, while pieces of clay found in this material had slightly elevated radium concentrations in the range of 1-2 pCi/g.

The fill and the substrate at the Central Florida Test Modules Florida Institute of Phosphate Research (FIPR) site had radium concentrations on the order of 5-8 pCi/g; these values are comparable to the median values observed for soil and fill at the Central Florida NHEP sites.

In 1992 a module was constructed in Central Florida to permit testing of the contribution of fill material to indoor radon. This site has a low near-surface radon source — radium concentrations in the first 1.5 m were on the order of 0.1 to 0.2 pCi/g. The test materials selected to represent "medium" radioactivity fill (waste sand tailings from phosphate rock beneficiation) had concentrations on the order of 4 pCi/g. The test materials selected to represent "hot" fill (phosphate rock concentrate, the beneficiation product), had concentrations on the order of 33 pCi/g. These concentrations are comparable to values typically reported for these materials and verify the selection of these materials to represent or simulate two levels of fill radioactivity.

Fill from a Central Florida source and in use in a test chamber had radium concentrations in the range of 4-6 pCi/g. These concentrations are comparable to those in the moderately elevated substrate and fill samples from the Central Florida NHEP sites.

Conclusions and Recommendations

The 1991 and 1992 work under this project leads to the following conclusions and recommendations.

1. The observations for North Florida support earlier conclusions (1989 and 1990) that a large portion of the fill actually used in Florida construction is of a low radium content. Availability of low radioactivity fill should not be a deterrent to adopting radioactivity standards for construction fill.
2. Elevated radium concentrations do occur in some Florida soil and fill samples in actual house construction. Building code development should continue to consider a soil/fill radioactivity standard.
3. Fill with elevated radioactivity can be an issue in selected circumstances (this was observed at the Central Florida NHEP sites). The

¹ In the report, the term "radon" designates the radon isotope, radon-222. The term "radium" denotes the radium isotope, radium-226.

extent and source of these fills should be investigated further.

4. Mining-related land (such as reclaimed overburden and/or sand tailings areas) may present a radon source. These soils may have characteristics different from those of undisturbed soils and directly excavated fills. The program should be reviewed to assess whether this land category is receiving adequate attention in sampling and radon potential modeling.

5. These and other studies indicate that, at some locations in North Central Florida, the near-surface soil gas radon may originate from deeper than 1 m. Therefore, sampling in this region should continue to be for a 2-m or greater depth profile, especially if elevated soil gas radon has been detected at the site.
6. The observation that the radon source may be deeper than 1 m indicates that shallow soil

samples, in the absence of additional information about the depth profile, may not be adequate for identifying radon potential.

7. With respect to the research houses and test modules, these laboratory analyses verified that the sites and test fills are generally representative of the conditions observed among the NHEP construction sites in the respective regions.

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David C. Sanchez is the EPA Project Officer (see below).

The complete report, entitled "Soil and Fill Laboratory Support—1992, Radiological Analyses, Florida Radon Research Program," (Order No. PB96-140579; Cost: \$17.50, subject to change) will be available only from:

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