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EPA **Project Summary**

Supplement to: Standard Measurement Protocols, Florida Radon Research Program

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The report supplements earlier published standard measurement protocols for the Florida Radon Research Program (EPA-600/8-91-212; NTIS PB92-115294, November 1991). It adds five new protocols: Small Canister Radon Flux and Soil Water Potential are added to the first section, on soil measurements; and Indoor Radon Progeny, Radon Entry Rate, and Duct System Leakage are added to the second section, on building measurements.

This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, 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

This manual is divided into two sections. The first section, soil measurements, initially contained field sampling protocols for soil gas permeability and radon concentration, *in situ* soil density, soil classification, and penetrometer analysis. Laboratory procedures included soil moisture, radium and radon emanation, particle-size analysis, specific gravity, the proctor method for moisture/density relationships, a laboratory gas permeability test, a radon diffusion coefficient measurement, and two radon flux measurements. The second section, building measurements, initially included diagnostic procedures for radon, sub-slab communications, and differential pressure measurements followed by building leakage measurements. To the first section, the supplement adds protocols for measuring radon flux (utilizing small canisters) and soil water potential. To the second section, the supplement adds protocols for: measuring indoor radon decay products, estimating radon entry rates, and measuring heating and air-conditioning duct leakage.

Small Canister Radon Flux

A third method for radon flux measurements is presented in the first section. It has been used by Florida Radon Research Program (FRRP) project members. This method is similar to the University of Florida version (see Section 1.12),* except that it reduces the air space between the soil surface and the charcoal bed to minimize biases from disturbed radon profiles.

Radon flux is a localized indicator of radon source strength, and has been used to define regulatory limits for radon emissions from uranium mill tailings piles, phosphogypsum stacks, etc. Radon flux measurements also may help identify the potential of building sites to cause elevated indoor radon levels.

This method is a variant of two similar methods for radon flux measurements given in Section 1.12. Radon flux measurements give an indication of radon source potential at a site. Source potential in turn is affected by soil radium and radon emanation, whose protocols are in Section 1.6, and diffusivity, which is related to Section 1.11.

* Referenced Sections 1.1 through 1.12 and 2.1 through 2.5 are in the initially published protocols.

Soil Water Potential

This method is used for field measurements of soil moisture potential. The moisture potential is defined to be the pressure of the tensiometer water necessary to equilibrate mechanically and hydraulically with the soil solution phase.

This method is specified as a field procedure and measurement to be conducted in the research house projects of the Florida Radon Research Program. As presented here, it is a "stand-alone" procedure used for long-term monitoring.

This method may not give a truly representative result if dissolved gases come out of the solution, if the water in the tensiometer system is reduced to the level of the vapor pressure of water at the ambient temperature of the system, or if the difference between the gas pressure and the pressure in the tensiometer cup water forces a gas phase through the wetted porous cup. Any of these phenomena that introduce a gas phase into the tensiometer system will seriously interfere with its operation. These conditions are most likely to occur when the soil is very dry.

This method is related to the determination of soil moisture as given in Section 1.5, in that the soil moisture and soil water potential for any given soil are monotonically related one to another.

Indoor Radon Progeny

Indoor Radon and Radon Decay Product Measurement Device Protocols. EPA-402/R-92-004 (NTIS PB92-206176), U.S. EPA, Office of Radiation Programs, Washington, DC, July 1992.

The referenced document contains indoor radon decay product measurement protocols utilizing three commonly used techniques. The method most suitable for use in FRRP projects is Protocol 3.1 (Continuous Working Level Monitors). Other radon and decay products methods are also included which are either already covered in the initial manual (Protocol 2.5 - Indoor Radon) or less likely to be applicable to the program. The protocol describes the method deployment strategies, operation, documentation, analysis, and quality assurance considerations.

This method is generally applicable to the FRRP research house projects, but may be applicable to any other FRRP project that requires information concerning radon progeny. Generally continuous working level monitors will be used in these projects. They will be deployed at least once a quarter when baseline indoor radon is being measured continuously. Such continuous simultaneous radon and radon progeny measurements will be made for at least 2 consecutive days each quarter. If occupant risks, progeny levels, or equilibrium ratios are of interest in any other of the specialty studies (depressurized conditions, various heating, ventilation, and air-conditioning (HVAC) conditions, etc.) of any of the research house groups, then similar continuous simultaneous measurements may be made. For certain of these special-purpose measurements, standard deployment procedures (closed house conditions, etc.) may deliberately be ignored. Because progeny may be measured under a variety of conditions, care must be taken to document the actual house conditions at the time of the measurement. For instance, the occupancy status, the HVAC operational mode, the open/closed conditions of interior as well as exterior doors and windows, and any pressurized or depressurized conditions should be noted.

Radon Entry Rate

The supplement contains a procedure for estimating radon entry rates through portions of the building envelope in communication with the soil or soil gas under controlled depressurization.

This method is for measuring radon concentrations inside a building after fixed times of controlled depressurization, during which the indoor-outdoor pressure differential and the exhaust flows are carefully measured to ensure as close to constant levels as possible. The method is most accurate when small temperature differentials and low wind-pressure conditions are maintained. This method requires fairly simple measurements and produces results that characterize the radon entry rates at various levels of depressurization. This can be extrapolated down to normal ranges of building pressure differentials.

This method will be used as a building diagnostic tool on several Florida Radon Research Program projects, including the Research House projects and the New House Evaluation Program projects. The test should not be run when strong wind and large indoor-outdoor temperature differentials are likely. Because of differences between the various conditions under which a building may be found and the test conditions on any given day, such measurements cannot be interpreted as direct measurements of radon entry rates that would occur on any given day. If the building has a very high leakage rate or if the radon source potential is very low, then the radon concentrations under depressurized, high exhaust flow conditions may be near or below detection limits of the instruments. However, buildings with these features tend not to have severe indoor radon concentration problems.

This method uses much of the same equipment as the Standard Test Method for Determining Air Leakage Rate by Fan Pressurization (Section 2.4.1; ASTM E779-87) and Alpha Scintillation Cell Grab Samples (Section 2.1) and Indoor Radon by grab sampling (Section 2.5).

Duct System Leakage

The supplement contains a simple heating and air-conditioning duct leakage protocol for determining: (1) if the air handler operation has a strong influence on the house pressure differential, and (2) a quantification of gross duct leakage. If either or both of these simplified protocols produce measurable results, then a more involved protocol is introduced for determining the external air leakage characteristics of the air distribution systems by fan pressurization. This more involved protocol is still being tested by an ASTM sub committee; so it cannot be reproduced here. A source to contact for information concerning the protocol is given.

These methods will be used as building diagnostic tools on several Florida Radon Research Program projects, including some Research House projects and the New House Evaluation projects. The tests should not be run on days with strong winds or large indoor-outdoor temperature differentials. Because of the difficulty in isolating the air handling system or its components from various zones of the building structures, it is not possible to determine precisely the duct leakage by these protocols. The problems vary as widely as the differences in individual houses and their unique air handling systems.

This method is an extension of the Standard Test Method for Determining Air Leakage Rate by Fan Pressurization (Section 2.4.1; ASTM E 779-87). Indeed it incorporates and supersedes the last four pages of Section 2.4.1, Test Method for Determining the HAC Duct System Leakage. It is also related to Trace Dilution Methods (Section 2.4.2; ASTM E 741-83).

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The complete report, entitled "Supplement to: Standard Measurement Protocols, Florida Radon Research Program," (Order No. PB94-144119/AS; Cost: $17.50; subject to change) will be available only from:
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