EPA/EERF-MANUAL-78-1

RADON

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

in Water Sampling Program

The Eastern Environmental Radiation Facility(EERF) is a field facility of the U.S. Environmental Protection Agency's Office of Radiation Programs(ORP).

Copies of this manual may be obtained by direct request to the EERF. To request copies of the manual, or for additional information concerning the procedures described herein, write to:

Eastern Environmental Radiation Facility

P.O. Box 3009

Montgomery, Alabama 36109

CONTENTS

I. Background 1

II. Sampling Program 2

A. Selection of Sampling Site 2

B. Sampling Kits 2

C. Sample Collection 2

D. Sample Data Form 10

E. Sample Log 10

F Return of Samples to EERF 10

List of Figures

Figure 1. Radon in water - sampling kit 3

Figure 2. Radon sampling kit - close-up 4

Figure 3. Connect tube to water supply 5

Figure 4. Allow water to slowly collect in funnel 6

Figure 5. Withdrawing water sample with syringe 7

Figure 6. Eject air bubbles and excess water 8

Figure 7. Inject sample into sample vial 9

Figure 8. Sample data form 11

I. Background

Radon-222 is an inert, noble gas and a radioactive decay product of radium-226. Radon diffuses through the underground geological strata and into underground aquifers and surface waters. These waters may also contain radium-226, but there does not appear to be a direct correlation between radium-226 and radon-222 concentrations. Radon exists in ground water at concentrations which are typically much greater than its immediate precursor, radium-226. This most likely occurs because radium-226 is trapped in the rocks, sands and clays which make up the aquifers while radon, as a noble gas, is much freer to migrate into the water.

Radon in drinking water has previously been considered a source of radiation exposure primarily from an ingestion standpoint. However, the Office of Radiation Programs (ORP) of the Environmental Protection Agency (EPA) is investigating radon in water supplies because of the possibility that a major pathway from inhalation exposure may exist, in addition to the ingestion pathway.

Previously, studies associated with the inhalation of radon were limited to miners and the mining industry, primarily the uranium mining industry. In 1970, the EPA assumed responsibility from the United States Public Health Service (PHS) for the investigation of radon and radon daughter exposures resulting from the use of uranium mill tailings. Since that time additional work has investigated radon exposures from natural gas, phosphate mining and milling practices, and the burning of coal in power plants.

Measurements of radon in water in the U.S. have been recorded as early as 1905, when abnormally high concentrations were found in the spring water of Hot Springs National Park, Arkansas. Since that time there have been numerous reports in the literature indicating radon-222 concentrations in selected water supplies in excess of 2,000 pCi/l. Specific geographic areas shown to have such high concentration include Maine, North Carolina, Texas, Arkansas, Florida, and Utah.

Dose estimates in the literature are generally based on radon progeny ingested with the water. However, more recent data indicates that inhalation of radon and radon progeny may produce significantly higher exposures. As an inert gas, radon is not chemically bound to the water and, consequently, can be released during any operation that aerates or agitates water. Measurements of radon releases from water in the home during clothes washing, dishwashing, showers, etc., demonstrated emanation percentages from 70 to 100 percent depending on the temperature of the water and the amount of agitation.

In addition to the release of radon in homes, large quantities of radon could be released in water treatment plants or by large industrial users of water. Water treatment plants that employ aeration, or industrial users who use water for spraying, cooling, etc., could be potential sources for radon released to the environment.

To determine the scope of this potential problem, a national sampling program is necessary to obtain data on radon in public and private water samples across the country. A suitable sampling kit has been developed by the Eastern Environmental Radiation Facility (EERF)) to collect water samples from many locations throughout the U.S. The kit is designed so that samples can be collected from any potable water supply and shipped, without loss of radon other than radioactive decay, to EERF for analysis.

The water samples will be collected, using a syringe, and added to a liquid scintillation vial containing a premeasured amount of liquid scintillation mix. The samples will be returned to EERF for analysis using a liquid scintillation counter. A mineral oil based liquid scintillation mix has been chosen to allow mailing of samples.

Sampling Program

A. Selection of Sampling Site

If special instructions are not given, the routine selection of a sampling site can be any location where the water is routinely used. This source can be any faucet that is easily accessible, e.g., an outside faucet at a service station, etc.

B. Sampling Kits (figures 1 and 2) are small lightweight carrying cases complete with all materials necessary for collecting potable water samples for radon-222 analysis. Each kit contains the following equipment:

1 sampling funnel and tube with standard faucet fitting

1 - slip-on faucet adapter

2 - 20 ml syringes

2 18 gauge two-inch hypodermic needles

20 to 30 glass scintillation vials with 10 ml solution each

C. Sample Collection

1. Attach the sampling funnel and tube to a faucet with either the standard faucet fitting or adapter (figure 3).

2. Slowly turn on the water and allow a steady stream to flow out of the funnel for approximately 2 minutes. This purges the tube and assures a fresh sample.

3. Reduce the flow of water and invert the funnel (figure 4). The flow should be adjusted to a level that does not cause turbulence in the pool of water contained in the funnel. Allow excess water to spill over one edge of the funnel.

4. Examine the hose connection and tubing for air bubbles or pockets. If these are visible, raise or lower the funnel until they are removed.

5. Place the tip of the hypodermic needle approximately 3 cm under the surface of the water in the funnel and withdraw a few ml of water and eject this water. Using this procedure, rinse the syringe and hypodermic needle two or three times.

6. *Again, place the tip of the needle approximately 3 cm below the surface of the water and withdraw 12 to 15 ml (figure 5).* ***NOTE: The water should be pulled into the syringe slowly to avoid extreme turbulence and collection of air bubbles. If large air bubbles are noticed in the syringe, the sample should be ejected and redrawn.***

7. Invert the syringe and slowly eject any small air bubbles and extra water (figure 6). Retain precisely 10 ml of water in the syringe.

8. Remove the cap from a vial and carefully place the tip of the needle into the bottom of the liquid scintillation solution (figure 7). Slowly eject the water from the syringe into the vial. ***NOTE: The water is injected under the liquid scintillation solution to prevent loss of radon from the sample. If the water is forced out of the syringe with much pressure, it will cause turbulence in the solution and could result in loss of radon.***

9. Carefully withdraw the hypodermic needle from the vial and replace the cap. The cap should be tightly secured to prevent leakage.

10. Repeat the previous steps to obtain two separate samples from each source. This completes the sample collection.

Figure 1. Radon in water - sampling kit.

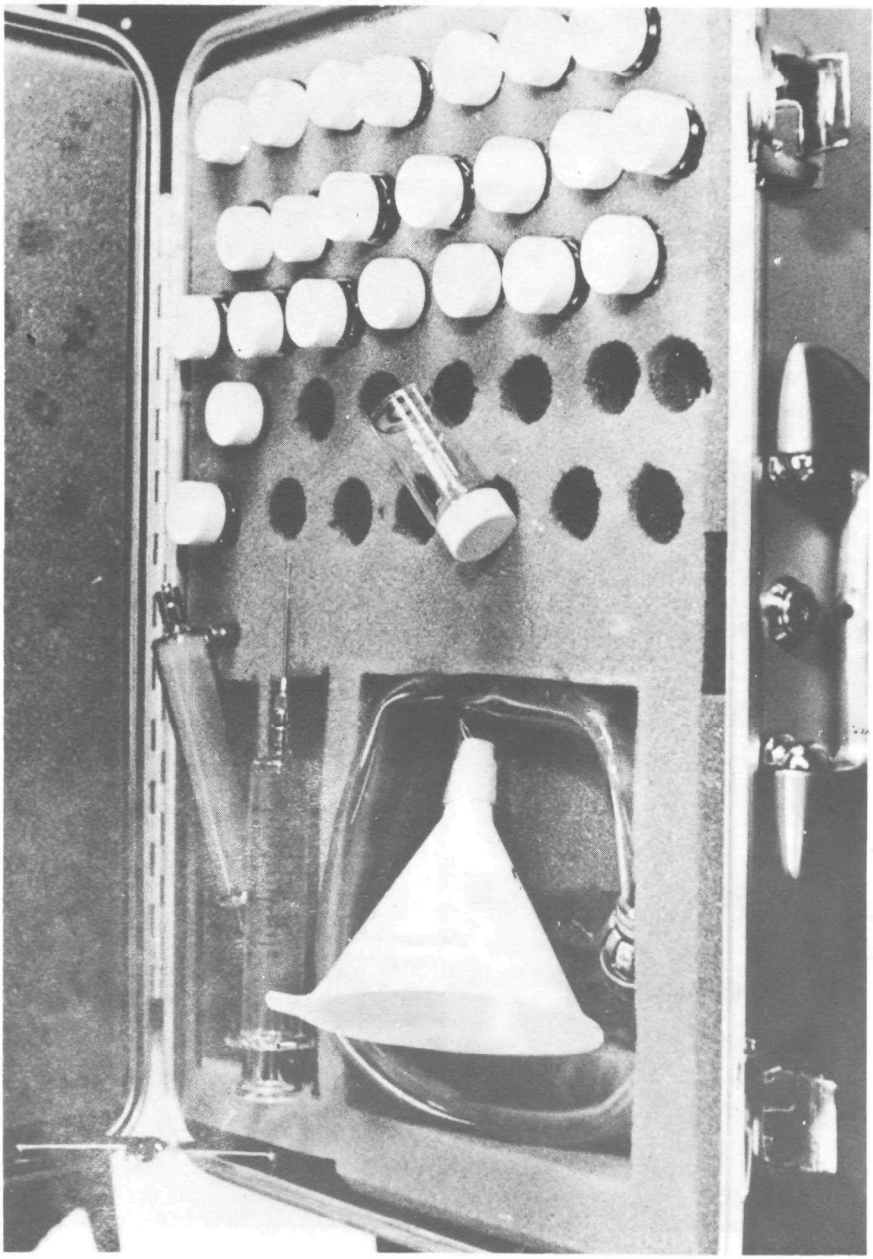

Figure 2. Radon sampling kit - close-up.

Figure 3. Connect tube to water supply.

Figure 4. Allow water to slowly collect in funnel.

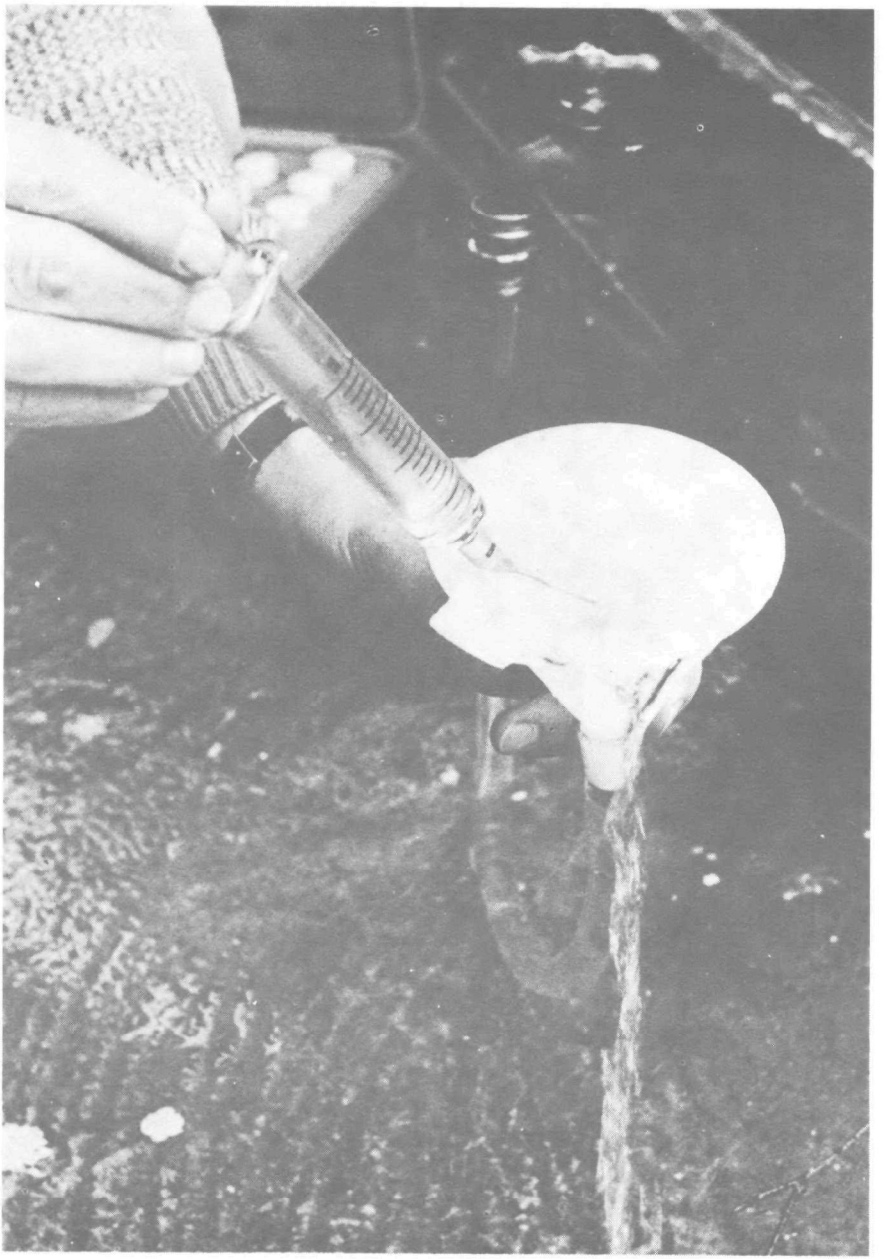

Figure 5. Withdrawing water sample with syringe.

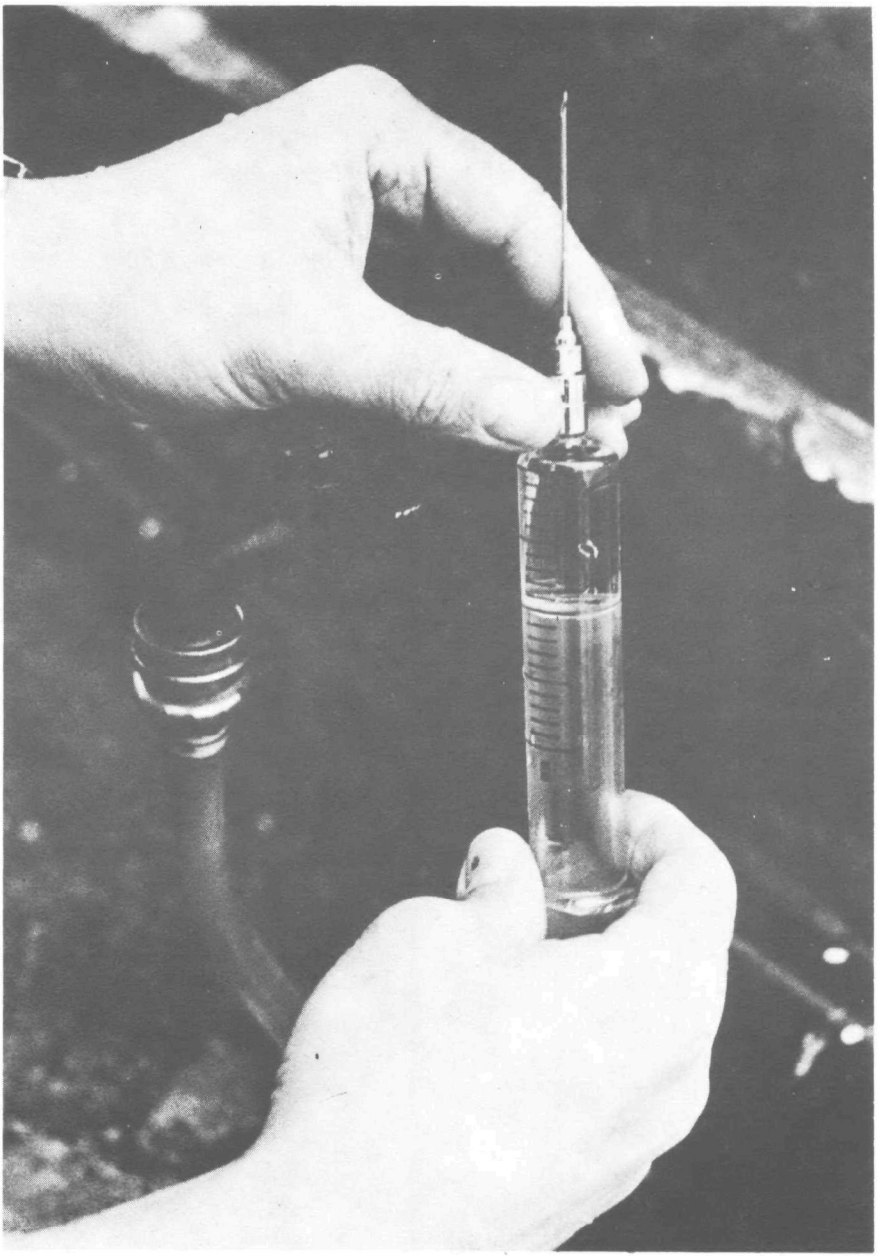

Figure 6. Eject air bubbles and excess water.

Figure 7. Inject sample into sample vial.

D. Sample Data Form - Figure 8. Provide the following information on the form:

1. Date that the sample is collected, e.g., 3/10/78.

2. Time of collection indicate the time of day that the sample was collected, e.g., 9:35 A.M. CST.

3. Sample numbers - the cap for each vial is prenumbered. Record this number for each sample collected at a site.

4. Location - identify the sampling location with as much detail as possible, e.g., street address, city, county, state, etc.

5. Description of Source - if the water source is a private well, mark the appropriate box and indicate the depth if known. If the source of water is a public (municipal) supply, then mark that box and indicate if it originates from groundwater wells (give depth, if available) or surface supplies. Provide any additional information concerning the water source that is available. Particularly useful information includes water treatment processes, aeration, chemical additives, etc.

6. Sample Collected By - provide the name, address, and phone number of the person who collects the samples.

E. Sample Log - A separate log containing the above information should be kept with the sample kit as backup data in the event of loss of the sample data form.

F. Return of Samples to EERF -

After collection of the samples, they will be mailed to the EERF for analysis. Each liquid scintillation vial should be individually wrapped with the absorbent material provided and placed in the self-addressed mailing tubes (two vials and the data form per tube). These mailing tubes will be provided by EERF separate from the sampling kit. The two samples from each source should be packaged and mailed as soon as possible. Due to the short half-life of radon-222 (3.8 days), the quick return of the samples for analysis is of primary importance.

Sample No.'s: _____

_____

Date: _____ Time of Collection: _____

Location: _____

_____

Description of Source: ☐ Private Well (Depth _____)

☐ Public Supply

☐ Groundwater (Well Depth_____)

or ☐ Surface Water (Lake, Reservoir, etc.)

Additional Information: _____

_____

Sample collected by: Name_____

Address_____

Phone_____

Figure 8. Sample data form.