

1. PUBLIC HEALTH STATEMENT

This Statement was prepared to give you information about radon and to emphasize the human health effects that may result from exposure to it. The Environmental Protection Agency (EPA) has identified 1,177 sites on its National Priorities List (NPL). Radon has been found above background levels at five of these sites. However, we do not know how many of the 1,177 NPL sites have been evaluated for radon. As EPA evaluates more sites, the number of sites at which radon is found may change. The information is important for you because plutonium may cause harmful health effects and because these sites are potential or actual sources of human exposure to radon.

When a radioactive chemical is released from a large area such as an industrial plant, or from a container such as a drum or bottle, it enters the environment as a radioactive chemical. This emission, which is also called a release, does not always lead to exposure. You can be exposed to a chemical only when you come into contact with the chemical. You may be exposed to it in the environment by breathing, eating, or drinking substances containing the chemical or from skin contact with it.

If you are exposed to a hazardous substance such as radon, several factors will determine whether harmful health effects will occur and what the type and severity of those health effects will be. These factors include the dose (how much), the duration (how long), the route or pathway by which you are exposed (breathing, eating, drinking, or skin contact), the other chemicals to which you are exposed, and your individual characteristics such as age, sex, nutritional status, family traits, life style, and state of health.

1.1 WHAT IS RADON?

Radon is a naturally occurring colorless, odorless, tasteless radioactive gas that is formed from the normal radioactive decay of uranium. Uranium is present in small amounts in most rocks and soil. It slowly breaks down to other products such as radium, which breaks down to radon. Some of the radon moves to the soil surface and enters the air, while some remains below the soil surface and enters the groundwater (water that flows and collects underground). Uranium has been around since the earth was formed and has a very long half-life (4.5 billion years), which is the amount of time required for one-half of uranium to break down. Uranium, radium, and thus radon, will continue to exist indefinitely at about the same levels as they do now.

Radon also undergoes radioactive decay and has a radioactive half-life of about 4 days. This means that one-half of a given amount of radon will be changed or decayed to other products every 4 days. When radon decays, it divides into two parts. One part is called radiation, and the second part is called a daughter. The daughter, like radon, is not stable; and it also divides into radiation and another daughter. Unlike radon, the daughters are metal and easily attach to dust and other particles in the air. The dividing

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of daughters continues until a stable, nonradioactive daughter is formed. During the decay process, alpha, beta, and gamma radiations are released. Alpha particles can travel only a short distance and cannot go through your skin. Beta particles can penetrate your skin, but they cannot go all the way through your body. Gamma radiation, however, can go all the way through your body. Thus there are several types of decay products that result from radon decay. You will find more information about the physical and chemical properties of radon in Chapter 3, about its uses in Chapter 4, and about your potential for exposure in Chapter 5.

1.2 HOW MIGHT I BE EXPOSED TO RADON?

Since radon is a gas and radon daughters are often attached to dust, you are exposed to them primarily by breathing them in. They are present in nearly all air. However, background levels of radon in outdoor air are generally quite low, about 0.003 to 2.6 picocuries of radon per liter of air. A picocurie is a very small amount of radioactivity equal to one quintillionth ($1/10^{18}$) of an ounce of radon. In indoor locations, such as homes, schools, or office buildings, levels of radon and daughters are generally higher than outdoor levels. Indoor radon levels are generally about 1.5 picocuries radon per liter of air. Cracks in the foundation or basement of your home may allow increased amounts of radon to move into your home. You may also be exposed to radon and daughters by drinking water obtained from wells that contain radon. Average levels of radon in groundwater are about 350 picocuries of radon per liter of water. However, most radon in water is rapidly released into the air and can be breathed in. In some areas of the country the amount of uranium and radium in some rock types, such as phosphate or granite, is high. In these areas radon levels in outdoor air or in groundwater will generally be higher. You will find more information on exposure to radon in Chapter 5.

1.3 HOW CAN RADON ENTER AND LEAVE MY BODY?

Radon and its radioactive daughters can enter your body when you breathe them in or swallow them. By far, the greater amounts are breathed in. Most of the radon is breathed out again. However, some radon and most of the daughters remain in your lungs and undergo radioactive decay. The radiation released during this process passes into lung tissue and is the cause of lung damage. Some of the radon that you swallow with drinking water passes through the walls of your stomach and intestine. After radon enters your blood stream most (greater than 90%) of the radon goes to the lungs where you breathe most of it out. This occurs very shortly after it is taken in. Any remaining radon undergoes decay. Radon that does not go to the lungs goes to other organs and fat where it may remain and undergo decay. There is very limited information on whether radon gas can penetrate the skin, but some radon may be able to pass through the skin when you bathe in water containing radon. You will find more information on behavior of radon in the body in Chapter 2.

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1.4 HOW CAN RADON AFFECT MY HEALTH?

Long-term exposure to radon and radon daughters in air increases your chances of getting lung cancer. When exposures are high, noncancer diseases of the lungs may occur, such as thickening of certain lung tissues. While noncancer health effects may occur within days or weeks after exposure to radon, it will be several years before cancer effects become apparent. This is known from studies of workers exposed to radon in mines, primarily uranium miners, and from tests on laboratory animals. Although radon is radioactive, it gives off little gamma radiation. Therefore, harmful health effects from external exposure (when the chemical does not come into direct contact with your body) are not likely to occur. In addition, it is not known if radon causes health effects other than to the lung. Also, the effects of drinking water or eating food containing radon are not known. You will find more information on the health effects of radon in Chapter 2.

1.5 WHAT LEVELS OF EXPOSURE HAVE RESULTED IN HARMFUL HEALTH EFFECTS?

In studies of uranium miners, workers exposed to radon levels of 50 to 150 picocuries of radon per liter of air for about 10 years have shown an increased frequency of lung cancer. Although there is some uncertainty as to how much exposure to radon increases your chances of getting lung cancer, the greater your exposure to radon, the greater your chance of developing lung cancer. Even small exposures may increase your risk of developing lung cancer, especially if you smoke cigarettes. Tables 1-1 and 1-2 were derived from animal and human data for short-term or long-term exposure, as described in Chapter 2 and in Table 2-1. This information provides a basis for comparison to radon levels that you might encounter in the air. As seen in Tables 1-3 and 1-4, there is no information on the effects of radon if you drink water or eat food containing radon.

1.6 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO RADON?

Radon in human tissues is not detectable by routine medical testing. However, several of its decay products can be detected in urine and in lung and bone tissue. These tests, however, are not generally available to the public and are of limited value since they cannot be used to accurately determine how much radon you were exposed to, nor can they be used to predict whether you will develop harmful health effects. You will find more information on methods used to investigate levels of radon in Chapters 2 and 6.

1.7 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH ?

EPA recommends that all homes should be monitored for radon. If testing shows levels less than 4 picocuries radon per liter of air, then no action is necessary. For levels above this, follow-up measurements should be taken. If

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TABLE 1-1. Human Health Effects from Breathing Radon*

Short-term Exposure (less than or equal to 14 days)		
<u>Levels in Air</u>	<u>Length of Exposure</u>	<u>Description of Effects</u>
		The health effects resulting from short-term exposure of humans to air containing specific levels of radon are not known.
Long-term Exposure (greater than 14 days)		
<u>Levels in Air (pCi/L)</u>	<u>Length of Exposure</u>	<u>Description of Effects**</u>
100	Occupational (10 years)	Severe lung damage.

*See Section 1.2 for a discussion of exposures encountered in daily life.

**These effects are listed at the lowest level at which they were first observed. They may also be seen at higher levels.

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TABLE 1-2. Animal Health Effects from Breathing Radon

Short-term Exposure (less than or equal to 14 days)		
<u>Levels in Air (pCi/L)</u>	<u>Length of Exposure</u>	<u>Description of Effects*</u>
2.2x10 ⁸	1 day	Death in mice
Long-term Exposure (greater than 14 days)		
<u>Levels in Air (pCi/L)</u>	<u>Length of Exposure</u>	<u>Description of Effects*</u>
2.6x10 ⁵	Life	Damage to lung tissue in hamsters.
5.5x10 ⁵	50 days	Lung damage in dogs.
4.8x10 ⁶	Life	Abnormal growth of cells in lung in rats.

*These effects are listed at the lowest level at which they were first observed. They may also be seen at higher levels.

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TABLE 1-3. Human Health Effects from Eating or Drinking Radon*

Short-term Exposure (less than or equal to 14 days)		
<u>Levels in Food</u>	<u>Length of Exposure</u>	<u>Description of Effects</u>
		The health effects resulting from short-term exposure of humans to food containing specific levels of radon are not known.
<u>Levels in Water</u>		The health effects resulting from short-term exposure of humans to water containing specific levels of radon are not known.
Long-term Exposure (greater than 14 days)		
<u>Levels in Food</u>	<u>Length of Exposure</u>	<u>Description of Effects</u>
		The health effects resulting from long-term exposure of humans to food containing specific levels of radon are not known.
<u>Levels in Water</u>		The health effects resulting from long-term exposure of humans to water containing specific levels of radon are not known.

*See Section 1.2 for a discussion of exposures encountered in daily life.

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TABLE 1-4. Animal Health Effects from Eating or Drinking Radon

Short-term Exposure (less than or equal to 14 days)		
<u>Levels in Food</u>	<u>Length of Exposure</u>	<u>Description of Effects</u>
		The health effects resulting from short-term exposure of animals to food containing specific levels of radon are not known.
<u>Levels in Water</u>		The health effects resulting from short-term exposure of animals to water containing specific levels of radon are not known.
Long-term Exposure (greater than 14 days)		
<u>Levels in Food</u>	<u>Length of Exposure</u>	<u>Description of Effects</u>
		The health effects resulting from long-term exposure of animals to food containing specific levels of radon are not known.
<u>Levels in Water</u>		The health effects of long-term exposure of animals to water containing specific levels of radon are not known.

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follow-up levels are 20 picocuries radon per liter of air or higher, the home owner should consider some type of procedure to decrease indoor radon levels. The Mine Safety and Health Administration (MSHA) uses a standard of 4 Working Level Months (WLM) per year for people who work in mines. (Working Level Months combine the amount with length of exposure.) You will find more information on guidelines and standards in Chapter 7.

1.8 WHERE CAN I GET MORE INFORMATION?

If you have any more questions or concerns not covered here, please contact your State Health or Environmental Department or:

Agency for Toxic Substances and Disease Registry
Division of Toxicology
1600 Clifton Road, E-29
Atlanta, Georgia 30333

This agency can also give you information on the location of the nearest occupational and environmental health clinics. Such clinics specialize in recognizing, evaluating, and treating illnesses that result from exposure to hazardous substances.