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## The Invisible Environment Fact Sheet Series

# Radon

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Radon is a colorless, odorless, tasteless gas that occurs naturally in most soils. Although you may not be aware of its presence, radon is a substance that poses the potential for lung cancer when a person is exposed to high levels over long periods of time. The Environmental Protection Agency (EPA) estimates that radon causes between 7,000 and 30,000 lung cancer deaths per year in the United States, making it the second leading cause of lung cancer behind smoking. Radon exposure has also been shown to increase the risk of lung cancer among smokers.

This fact sheet describes how radon forms in soils, how it infiltrates our living areas, how you can detect it, and what measures you can take to reduce your exposure to it.

### What Is Radon?

Radon-222 is a radioactive gas that is produced by the decay of uranium-238, which is found in varying degrees of concentration in most soils, in rock, and in ground water. As uranium-238 decays, radon-222 is formed. It, in turn, decays into various particles that can be inhaled in the air we breathe. Most of the time radon enters the lower levels of buildings through cracks in foundations or openings around pipes. Once inside, it is free to move about, and dissipates as it does so. For this reason, concentrations are usually higher in lower levels of buildings as compared to upper levels.

After the energy crises of the 1970s, some experts argued that advances in building construction to conserve energy made it more likely that radon concentrations could be elevated indoors. Studies undertaken over the past decade however, have not substantiated this claim.

Radon levels have not been found to be higher in well-insulated homes. Thus, concern about radon should not prevent anyone from taking steps to making living quarters more energy efficient.

While most radon literature focuses upon the airborne variety of radon derived directly from soils and rock, it should be noted that ground water may be contaminated also. This poses a threat for those whose water comes from wells. When contaminated water is used inside the home, especially when heated, sprayed, or agitated (for baths, washing dishes, etc.) it releases radon into the air, posing a threat to the inhabitants. Radon is not a hazard in city water because it is removed naturally from the water while it is in the reservoir or holding tank.

The amount of radon concentration in the air is measured in picocuries per liter (pCi/l). The average concentration found in outdoor air is .4 pCi/l. While no amount of radon is considered "safe," the EPA sets the limits for remedial action at 4 pCi/l. It is estimated that between 5 percent and 30 percent of all homes in the United States have levels above 4 pCi/l, and that as many as 20 percent of all schools have levels in excess of this amount. Some estimates indicate that roughly half a million homes have wells with unsafe levels. It should be noted that widespread, systematic testing has not been carried out, so it is simply not possible to give firm statistics on the extent of contamination.

### Detection

Testing is the only way to determine radon concentrations in air or water. Fortunately, a variety of accurate,

simple, and relatively inexpensive test kits are available in most hardware stores. The EPA tests these kits periodically, and requires each kit to measure within 25 percent of the EPA level in order to get approval. However, this approval is voluntary—no company is required to participate. Usually, if the kit has been approved, this will be indicated on the package. If you are unsure, you may obtain an updated list of companies meeting EPA standards by writing to EPA Office of Radiation Programs, Washington, DC 20460.

The most common type of kit requires exposure to the air in the tested area for either a two- or seven-day period. The advantage of the seven-day kit is that it is usually considered to measure a more representative sample of the air where the test is being conducted. This is because concentrations may fluctuate for a variety of reasons over time. The testing procedure requires that the sample be sent to a laboratory, with the results being returned within two weeks. The average cost of a kit is \$25 to \$35. Kits for testing well water are also usually available at about the same cost. You can download a coupon for radon tests at <http://www.nsc.org/issues/radon/radonkitcoupons.pdf> courtesy of the National Safety Council.

### **Corrective Measures for Airborne Radon**

If you have an airborne reading of 4 pCi/l or higher, the EPA recommends that you take action to reduce the radon concentration. Remedies range from relatively simple steps you can take yourself, to expensive and sophisticated measures that may require a professional. As a short-term measure, simply creating a way for ventilation to occur may be an appropriate first step. This may just involve opening a window, or some other way of venting the air. One rule of thumb is that if you can feel a draft, it is probably sufficient to provide a significant reduction in radon concentration. The primary problem with a solution like this is that it may increase winter heating and summer cooling bills substantially. Thus, in the long term, other approaches should be considered.

A more sophisticated method of radon reduction is called heat recovery ventilation, or energy recovery ventilation (HRV or ERV). This involves the use of a device called an air to air heat exchanger, which draws air from outdoors, heats it or cools it to room temperature, and then forces indoor air out through an exhaust. Usually this system requires installation by a heating and air conditioning professional, but do-it-yourself devices are available. This type of system is relatively expensive to install and operate. Professional installation of an HRV system averages around \$2,000. Annual operating costs

are about \$75, plus an additional 25 percent increase in heating and cooling costs. A principal advantage of this system is that it provides a greater turnover of indoor air, driving out other forms of indoor air pollution.

One of the most widely used procedures is called sub-slab ventilation. This involves inserting pipes through the basement floor. These pipes draw radon that accumulates beneath the floor. They are connected to an exhaust fan, which pulls the radon rich air outside. While this system is typically among the most expensive to install, it is also among the least expensive to operate, involving relatively little energy loss. This method will only be practical when the foundation is sound and the soil permeability is appropriate. The cost of professional installation varies widely, based primarily upon the number of pipes needed (usually one per 700 square feet). A single pipe system averages about \$1,000. Annual operating costs are about \$150, including the higher utility bills associated with the energy loss.

A different approach to radon reduction is to provide a more effective barrier to prevent the gas from entering the building. This involves sealing openings around pipes and other areas where radon may enter, such as cracks in the foundation. This type of prevention would seem to be desirable even if other methods are used. However, it may not be sufficient on its own because radon may enter even through extremely small openings that are very difficult to spot. Because of these considerations, the EPA recommends that this work be done by a professional. Costs vary widely, but average between \$500 and \$1,000.

A building may also be pressurized so that the air inside is at a higher pressure than contaminated air under the soil. This technique requires professional installation and a tightly sealed basement. It is relatively expensive to install and operate. However, it has been shown to be extremely effective in reducing even high levels of radon in a variety of buildings, including schools.

If you are seeking professional help for radon detection and/or remediation, you can probably find a list of firms in your area that do this type of work in the Yellow Pages under “radon testing and mitigation.”

Once any corrective measure is taken to reduce radon concentrations, the air should be tested again periodically, since there is no other way of knowing how effective the steps taken have been in removing contamination.

### **Corrective Measures for Contaminated Wells**

Tests have revealed that during showers using contaminated water, bathroom levels of radon have risen from the

normal indoor level of 1 pCi/l to several thousand pCi/l within minutes. Restoration of the normal level may then take hours, if ventilation is not accomplished. Typically a radon concentration in water of 10,000 pCi/l is believed to translate into an airborne level of 1 pCi/l.

If well water is found to be contaminated, one of two approaches to removal may be used. One involves moving the water to a space where the radon may be removed naturally by exposing it to air, such as a holding tank. Forcing air into the water (aeration) speeds up the process. The important

thing to remember when using this type of method is to ensure that the water does not become contaminated with any other material during the process. The second form of radon removal from water involves the use of a filter that traps the radon in the water before it is exposed to the air. Extreme care must be used when removing such a filter, since it is a source of radon contamination. If neither of these systems is currently in use, a substantial amount of reduction can be achieved by ventilating bathroom air to the outside immediately after showering.

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