Radon: Facts and Preventative Measures

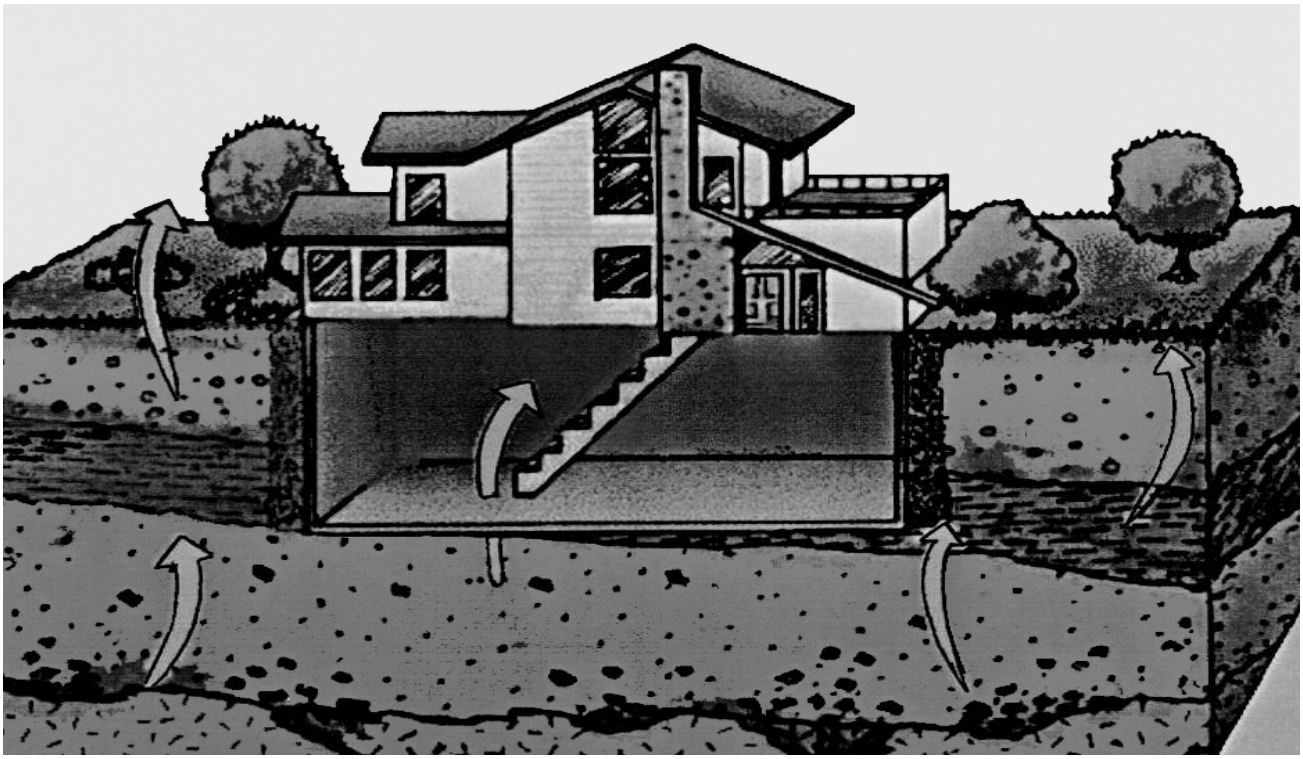
Important Facts About Radon

Radon is an odorless, invisible and tasteless gas. It does not burn the eyes or turn the air black. It is not emitted from barrels or industrial smokestacks. However, radon exposure has become a significant human health concern because this gas is radioactive. Exposure to radon occurs within our home, school, and workplace environments. The health effects of radon do not become apparent until several years after exposure. This pamphlet discusses the facts about radon, how to test for its presence, what the results of testing actually mean, and how to decrease the threat of exposure.

Radon-222 comes from the natural breakdown (radioactive decay) of uranium-238. It can be found in high concentrations in soils and rocks containing uranium, granite, shale, phosphate, and pitch blend. It can also be found in soils contaminated with certain types of industrial wastes, such as the byproducts of uranium or phosphate mining and may also be found in well water supplies.

Radon-222 is a threat as a source of indoor air pollution. It has a half-life of 3.8 days, which is enough time to escape from rocks and soil and enter the indoor environment. The elements produced from the original element are called radioactive decay products or daughters and progeny. When decay occurs, radioactive alpha particles are emitted. Radon-222 produces polonium-218, lead-214, bismuth-214, and polonium-214. Radon and its daughters may be carried by air currents and become attached to aerosols, droplets, dust, or surfaces. When inhaled by humans, these products irradiate lung tissues as the process of radioactive decay continues.

Radon as an indoor air pollutant has not been assessed until lately. A recent study found evidence that the presence of radon in the home may account for one in 20 cases of lung cancer. Of the 100,000 people who die of lung cancer each year, 80% of the deaths can be attributed to smokers while 5-20% may be related to radon. The incidence of lung cancer associated with smoking one pack of cigarettes a day for a lifetime is 6%. Exposure to radon and radon daughters above the limit recommended by the Environmental Protection Agency (EPA) is hypothesized to correspond to a lifetime lung cancer risk of 1%. This may be comparable to smoking 1-3 cigarettes per day for a lifetime. Thus, a combination of smoking cigarettes and living exposed to radon greatly increases one's chance of developing lung cancer.



Radon gas, a radioactive product of uranium, can reach high levels in some houses, depending on the local geography and house condition.

How Does Radon Cause Cancer?

Radon and its daughter products enter the body by inhalation and ingestion. Most radon gas is exhaled, however some remains, which allows radon decay to produce daughter progeny. The alpha radiation penetrates the bronchial epithelium and irradiates lung tissue. Radon and its daughter progeny can attach directly to the lung lining and other tissues in the body. The lung tissue DNA can be damaged and if unable to repair itself, the damage may be expressed at a later time as uncontrollable or cancerous cell growth resulting in lung cancer. Other tissues of the body such as the stomach may be similarly affected.

What is Considered a Safe Level of Radon Exposure?

Concentration of radon gas is expressed as picocuries, a measurement of radioactivity, per liter volume of air (pCi/L). A picocurie represents the breakdown (decay) of about two radon gas atoms per minute per liter of air. Another parameter used to express the concentration of radon in air is the Working Level (WL). A Working Level is defined as that concentration of radon daughters having a potential alpha energy release of 1.3 x 105 me V/L of air. This is the potential alpha energy concentration of the short-lived progeny of radon in equilibrium with 100 pCi/L of radon-222. Based upon this information, the EPA has chosen 0.02 WL, equivalent to 4 pCi/L of radon-222, as the guideline for upper limit exposure in homes. The concentration of radon in the atmosphere in Tennessee is 0.4 picocuries/liter (the normal exposure level for the country is 0.2 picocuries/liter).

Methods for Evaluating the Presence of Radon

The two easiest methods used to screen for radon contamination are the charcoal canister and the alpha-track detector. These test kits (EPA approved as indicated on the label) are generally available from hardware stores, supermarkets, and other retail outlets, and also through the mail for prices ranging from $10 to $45. Other methods may be used but are expensive and really not warranted for initial assessments.

1) The charcoal canister test: When the test is begun, the canister is opened and placed a) in the livable area closest to the soil (basement), b) about 2 feet off the floor, c) in an undisturbed area and d) under closed house conditions (spring and summer can present problems). The canister is left in the basement for 3-7 days. At the completion of the test, the charcoal canister is sent to a laboratory for evaluation and the results returned to the consumer. It is important that once the test begins that the protocol be strictly followed to obtain the most accurate information. For example, a test kit evaluated 30 days after the specified exposure time will have a much lower radon reading than one that was evaluated immediately following the 3-7 day test period. This is because the test is evaluating radon, which has a half-life of 3.8 days. The longer the test evaluation is delayed, the fewer radon counts will be detected. The chief advantage of this screening test is its low price and short time to obtain results. The chief disadvantage is that it may not provide an accurate picture of exposure because conditions can fluctuate during different seasons.

2) The alpha track detector: The minimum test period for this test kit is 2-4 weeks, but may be as long as six months to a year. The alpha detector is a small round device that can be hung from the ceiling in the basement. It must remain undisturbed for the length of the test. At the end of the test period, it is sent to a laboratory for analysis. This test does not measure radon particles, instead it measures radiation damage recorded on a plastic plate. This damage is assessed microscopically. Therefore, the alpha track is used over a longer period of time with no threat of lost information. The advantage of this method of screening is the increased accuracy of the test. The disadvantages include its price and the exposure time required collecting valid data.

Depending on the results obtained, there may be a need to do follow-up testing to provide more accurate information regarding radon levels in the home (see table). Concentrations are usually reported in picocuries/liter, but may also be reported as Working Levels.

It is important to complete the follow-up measurements before doing any remediation. The charcoal canister and alpha track devices can be used to obtain these follow-up measurements. The follow-up measurements should be made in at least two living areas of the home. If the home has living areas on two floors, measurements should be made on each floor. The results of follow-up tests provide an indication of the average concentration throughout the home. The actual health risk depends on the amount of time spent by people in the home.

Recommended Action Based on Follow-Up Results

Level pCi/L	Level WL	Action Recommended
< 4	< 0.02	Follow-up testing probably not required if the screening test was made with the house closed up.
4 - 20	0.02 - 0.1	Perform follow-up measurements. Expose detectors for 1 year, or make measure ments no more than one week during 4 seasons.
20 - 200	0.1 - 1.0	Perform follow-up measurements. Expose alpha detectors for no more than 3 months. Doors and windows should be closed as much as possible during testing.
>200	> 1.0	Perform follow-up measurements as soon as possible. Expose detectors for no more than 1 week. Doors and windows should be closed as much as possible during testing. Consider taking actions immediately to decrease levels of radon.

Major Radon Entry Routes

Certain geological formations appear to influence radon concentrations. For example, radon concentrations are relatively higher in uranium, granite, or phosphate-rich areas. Radon can enter homes through many routes. The main entry is through the soil and rock underneath the house. Because of air current flow due to fireplaces, windows, and fans, the house pulls in air from the ground. Another route of exposure may be through well water and groundwater that has passed through soil and rock beds. Radon can enter through cracks in the basement floors, foundation walls, space around joints, pipes, drains, etc. Radon that escapes the earth's crust can also enter the home. Some building materials contain radium, for example, certain types of concrete and cement, stone, brick, ceramic tile, and gypsum board. Certain types of construction such as earthen homes and solar-heated structures with rock heat storage may have high levels of radon because of the additional earth and rock used in such buildings. Phosphate slag (used from 1962 to 1977 in concrete foundations of homes built in Idaho) can be a significant source of radon.

Home Characteristics Linked to Radon Pollution

- Homes built on a slab.
- Homes with basements.
- Homes without fully ventilated crawl spaces.
- Homes with a sump pump.
- Homes supplied with private well water.
- Homes built on debris from uranium or phosphate mining.
- Homes built on radium-rich rock (granite).
- Homes that have been weatherized (insulated).

Decreasing Personal Risk

- Stop smoking and discourage smoking in your home.
- Spend less time in areas with higher concentrations of radon such as the basement.
- Determine the level of radon in your home and decrease it as much as possible.
- Whenever practical, open all windows and turn on fans to increase the air flow into and through the house. This is especially important in the basement.

Decreasing Radon Exposure in the Home

- Preventing or decreasing radon entry into the house.
- Removing the radon after it has entered the house.

Preventing Radon Entry in the Home

- Sealing and closing of all pores, voids, open joints, and exposed earth that permit soil-gas entry.
- Reversing the predominant direction of soil-gas borne radon flows so that air movement is from the house to the soil and outside air. This can be accomplished by locating a uniformly exhausting ventilation system around the perimeter or under a basement slab. This requires control techniques that lower the soil air pressure relative to that of the house pressure relative to the soil.
- Avoid use of water supplies containing radon or removing radon from portable water supplies through the use of aeration or carbon absorption techniques.
- Avoid use of building materials that may contain radium and release radon such as granite.

Choice of a Contractor

In choosing a contractor to remedy a radon problem be sure to carefully determine whether the company has the appropriate experience. Ask for proof of certification and references. Prices for remediation are site-specific for each area.

For More Information Call:

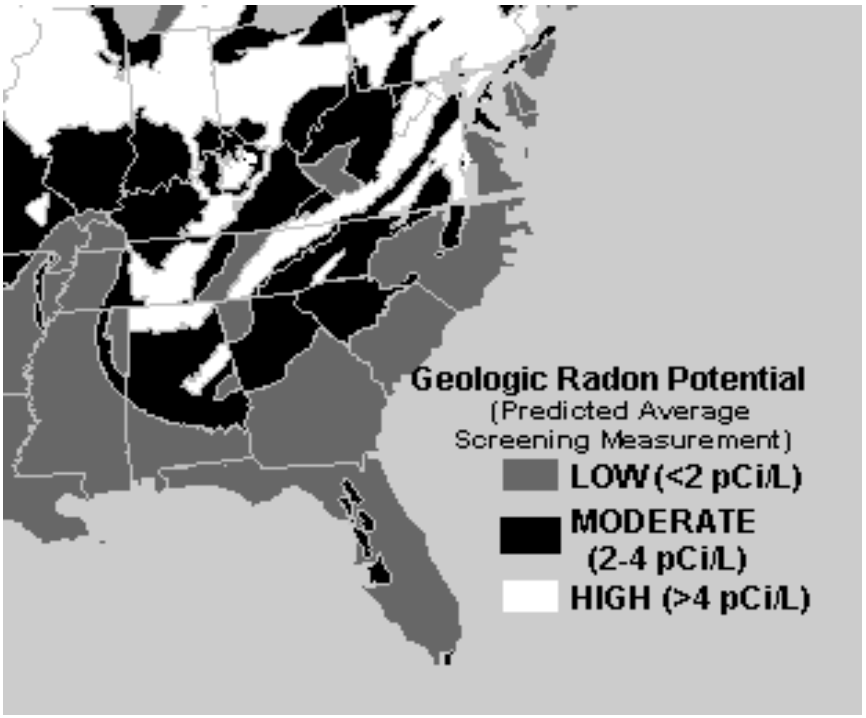
Tennessee Radon Information
(24 h): **(800) 232-1139**

Tennessee Department of Environment and Conservation - Division of Air Pollution Control
(8 AM - 5 PM): **(615) 532-0554**

Nationwide Radon Information Line
(24 h): **(800) 767-7236**

The Radon FIX-IT Program at
(24 h): **(800) 644-6999**

American Lung Association
(24h): (800) 432-5864



Geologic Radon Potential of the Southast U.S.
(by the US Geological Survey)

For Radon Information on the World Wide Web:

US Geologic Survey - **http://sedwww.cr.usgs.gov:8080/radon/radonhome.html**

Environmental Protection Agency - **http://www.epa.gov/iaq/radon/**

The National Safety Council's Environmental Health Center - **http://www.nsc.org/ehc/airqual.htm**

POISON LIFELINE
Your call could save a life.

Poison Center Hotlines

Greater Nashville Area Hotline: **936-2034**
Regional Hotline: **800-288-9999**

Middle Tennessee Poison Center
501 Oxford House, 1161 21 st. Avenue, South
Nashville, TN 37232-4632
Office Phone: 615-936-0760

www.poisonlifeline.org

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