Consumer Guide On
Radon mitigation

A REPORT ON THE EFFECT OF RADON GAS IN THE HOME

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INTRODUCTION

What is Radon?

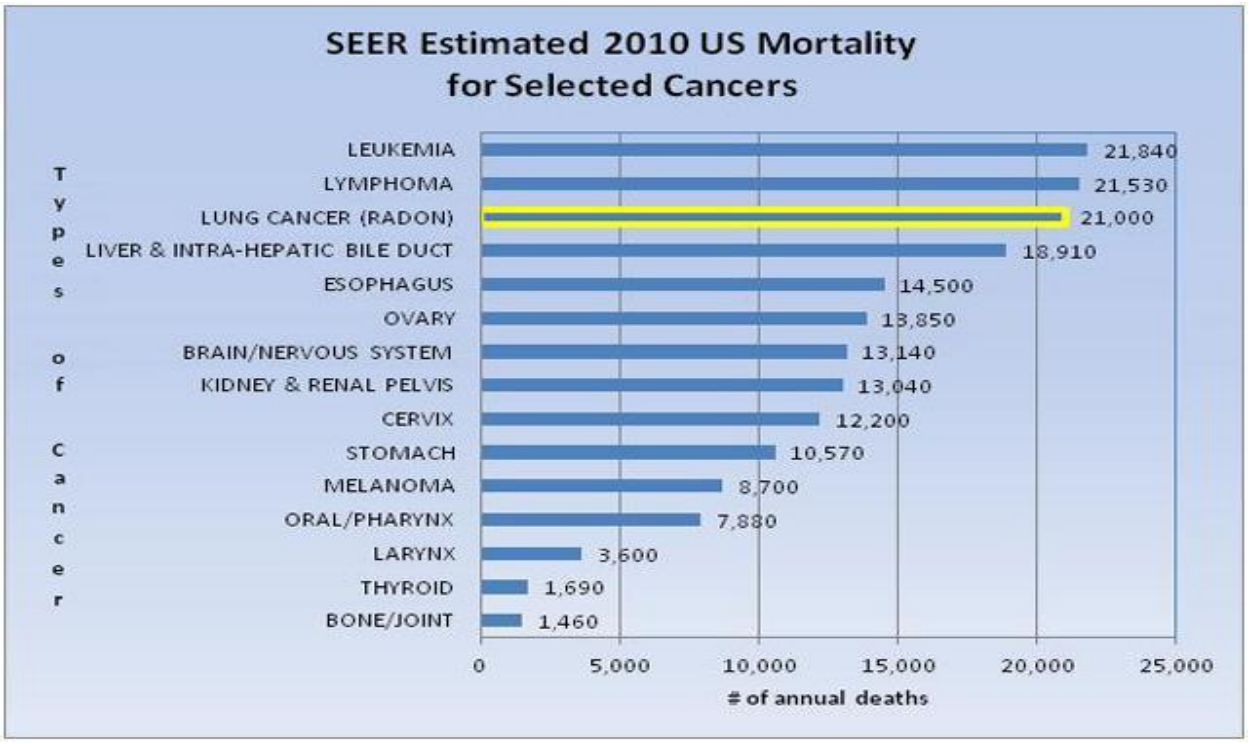
Radon is a naturally occurring radioactive gas that causes cancer, it cannot be seen, tasted nor does It have a smell. It is produced by the natural breakdown (radioactive decay) of Uranium-238 in the soil, rock and water. Radon gas concentrations are higher where uranium is plentiful in the soil. It has a half-life of only 3.825 days hence it takes about 4 days to reproduce itself emitting alpha particles and lead. Radon has a big impact on indoor air quality and it has been found in high levels in homes in the US. Statistically one in fifteen homes has radon concentration levels above 4 picocuries per liter (4pCi/L), the EPA action level.

Health Effects of Radon

Radon is the second highest cause of lung cancer in countries with high level of Uranium elements in their soil, smoking takes the lead in smokers but Radon is the number one cause of lung cancer among non-smokers (estimates by EPA). Annually, 160,000 lung cancer deaths are recorded in the United States, about 12% of this is due to radon exposure, the rest is due to smoking (passive or conscious smoker). Estimates by National Academy of Sciences say radon is estimated to cause about 21,000 deaths per year. From the time of diagnosis, between 11 and 15 percent of those cases will live beyond five years, depending upon environmental factors. According to the US EPA, 1 in 3 homes checked in seven states and on three Indian lands had screening levels over 4 pCi/L (EPA's action level for radon exposure). Other effects of Radon exposure may include frequent attacks in asthma patients, allergic reaction trigger and respiratory issues, trouble breathing, Dizziness, fatigue depression, shortness of breath, Sinus congestion, incessant sneezing and coughs frequent case of nausea and headaches, eye and nose irritation. These may be symptoms of another unrelated sickness but it’s always recommended to take out Radon indoor air pollution.

Average Radon Exposure	Lifetime Risk of Lung Cancer (per person) from Radon	
	Persons who Never Smokes	Current Smokers
8 pCi/L	15 in 1,000	120 in 1,000
4 pCi/L	7 in 1,000	62 in 1,000
2 pCi/L	4 in 1,000	32 in 1,000
1.3 pCi/L	2 in 1,000	20 in 1,000
0.4 pCi/L	_____	3 in 1,000

EPA Risk Estimates (Based on 1999 NAS Report) for Long Term Radon Exposure in Homes

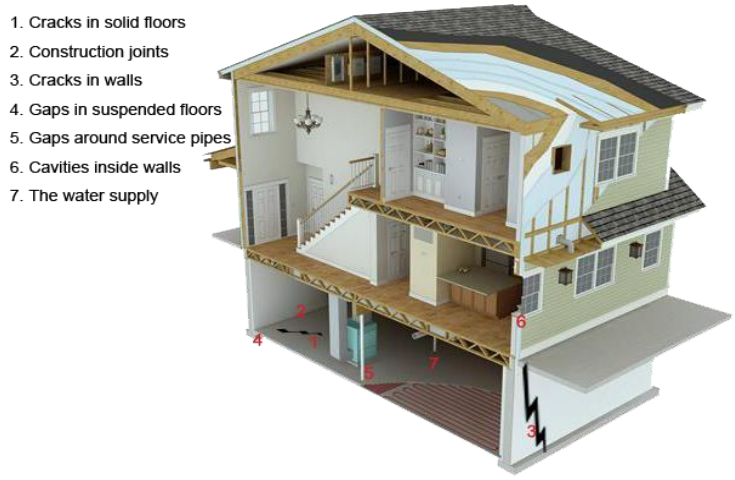


Sources of Radon in the Home

The primary source of Radon is the soil. It comes from the natural breakdown (radioactive decay) of uranium which is usually found in igneous rock and the soil. The normal radon concentrations in a depth of 1 metre under the earth's surface is usually higher than 10,000 Bq/m^3. Radon gas can enter the house by process of diffusion through cracks in the concrete slabs, floors and walls and also as a consequence of natural negative pressure that arises in the house, especially in the hot season (stack effect). Radon is a single atom gas (inert gas) unlike oxygen gas O_2 which comprised of two atoms, this property makes it easy to penetrate materials like paper, leather, low density plastic, paints, and building materials like gypsum board (sheetrock), concrete block, mortar, sheathing paper (tarpaper), wood paneling, and many insulations.

Other sources of radon are building materials such as slag, fly ash, etc. and Underground water(wells) from which radon can be released during showering or other activities. Radon in water is a much smaller factor in radon exposure than radon in soil. Underground water shows concentrations ranging from 10 to 1,000 Bq/l.

Radon gas is inhaled with oxygen in the air within the home, the gas lodges in the lungs where it radiates within the cells lining the respiratory system. The radioactive decay of the radon emits alpha particles and lead that damages the lung tissues. Small exposures to radon can increase the probability of cancer in smokers, Exposure to a higher dosage enhances the risk of lung cancer in all. The effect of radon among smokers is about 9 times higher than in non-smokers.



Radon mitigation system?

These are steps or systems designed to reduce radon concentrations in the indoor air of occupied buildings. Mitigation of radon in the air can be accomplished through ventilation of gas either collected below a concrete floor slab or membrane on the ground, or by increasing the air changes per hour in the building. Radon levels can only be detected only through testing**.** The EPA recommends that necessary actions be taken to reduce home's indoor radon levels if radon test result is 4 pCi/L or higher.

The following steps can help you reduce radon in your home:

- Select a qualified radon mitigation contractor to reduce the radon levels in your home.
- Determine an appropriate radon reduction method.
- Maintain your radon reduction system

Radon Testing: Radon is a national environmental health problem and due to its properties, it usually takes years of exposure before any visible problems surface and by then it may be too late. The first step in radon mitigation is testing, to see if the indoor-air and/or domestic water radon concentrations should be reduced. No level of radiation is considered completely safe but since it cannot be completely eliminated hence governments around the world have set various action levels to provide guidance on when radon concentrations should be reduced. The World Health Organisation has recommended an action level of 2.7 pCi/l for radon in the air. Radon in the air is considered to be a larger health threat than radon in domestic water hence recommendation is to not test for radon in water unless a radon in air test is above the action level. In areas where radon levels are higher than the national average, water from the well should be tested for radon. Air-radon levels fluctuate naturally with change in the weather conditions and seasons. A short term test (90 days or less) might not be an accurate assessment of a home's average radon level, but is recommended for initial testing to quickly determine unhealthy conditions. Transient weather such as wind and changes in environmental pressure can affect short-term concentration as well as ventilation such as open windows and the operation of exhaust fans.

Testing can be done by a professional indoor air service company like Simon air Quality or using a do-it-yourself kit. It is important that either the professional service or home test kit be EPA-approved. Testing for radon in the air is accomplished using passive or active devices placed in the building. Some devices are promptly sent to a laboratory for analysis, others calculate the results on-site. Retesting is recommended in several situations to double check test results before spending money on the installation of a mitigation system. Test results which exceed accuracy tolerances also require re-testing. When a mitigation system installation is warranted, a retest after the system is functional is advised to be sure the system is effectively reducing the radon concentration below the action level, and after any mitigation system repairs such as replacing a fan unit. Retesting is also recommended every ten years.

What are the benefits of radon mitigation?

The health benefit is the most significant of all because Health is wealth. Reducing the risk of developing lung cancer in non-smokers and smokers alike. Standard radon reduction procedures are usually effective within the first 24 hours of its implementation and maintained at low levels as long as there is proper aeration. Another benefit of these systems is reduced infiltration of soil air with the radon, which may reduce the humidity level in the basement of the home allowing for better temperature throughout.

Your house architecture and material used will affect the kind of radon reduction system that will work best for you. Houses are generally categorized according to their foundation design, some house have single foundation design like cellar, slab-on-grade (concrete poured at ground level), or shallow unfinished space under the main floor basement.

Others have more than one foundation design feature it is common to have a basement under part of the house and to have a slab-on-grade or crawlspace under the rest of the house. In these situations, a combination of different radon reduction techniques may be needed to reduce radon levels to below 4 pCi/L.

Types of Radon Mitigation

In homes that have a basement or a slab-on-grade foundation, radon is usually reduced by one of four types of soil suction:

Subslab Suction This is also known as subslab depressurization. One or more suction pipes are inserted through the floor slab into the crushed rock or soil underneath. They also may be inserted below the concrete slab from outside the home. The number and location of suction pipes that are needed depends on how easily air can move in the crushed rock or soil under the slab and on the strength of the radon source. Often, only a single suction point is needed. This done after extensive tests visual inspection from features due to experience. A vent fan connected to the suction pipes draws the radon gas from below the home and releases it into the outdoor air simultaneously creating a negative pressure or vacuum beneath the slab.

Drain-Tile Suction: Some homes have drain tiles or perforated pipe to direct water away from the foundation of the home. Suction on these tiles or pipes is often effective in reducing radon levels.

Sump-Hole Suction One variation of subslab and drain tile suction is sump-hole suction. Often, when a home with a basement has a sump pump to remove unwanted water, the sump can be capped so that it can continue to drain water and serve as the location for a radon suction pipe.

Block-Wall Suction Block-wall suction can be used in basement homes with hollow block foundation walls. This method removes radon and depressurizes the block wall, similar to subslab suction. This method is often used in combination with subslab suction.

Home mitigation techniques

Air Cleaners

This method concentrates on removing radon gas or preventing radon gas from even entering the house. Since the radon health effect is associated with the products of radon decay (alpha particles and lead), and not the radon itself (which is an inert gas), it is appropriate to ask whether it is possible to remove the radon decay products without removing the radon gas itself. Air cleaners are devices which either filter or electrostatically remove particles like dust, alpha particles or radon decay products from the air. Air cleaners are commonly used to condition indoor air for a variety of health and comfort reasons, and there have been attempts to market air cleaners to reduce radon decay products. At this time, EPA does not endorse the use of air cleaners as a method of reducing radon decay products in indoor air because this technology has not been demonstrated to be effective in reducing the health risks associated with radon. Some research has been done on using charcoal to filter the air although extremely large quantities of charcoal would be required and it is not yet a demonstrated or even clearly feasible approach.

Natural Ventilation

The opening of windows, doors, and vents is a very effective, universally acceptable radon reduction technique that can be readily implemented by the homeowner thereby replacing radon-laden indoor air with outdoor air and neutralizes pressure. Natural ventilation occurs due to difference in temperature and pressure in indoor and outdoor air in every house as air is drawn in through t openings. If done properly, natural ventilation is consistently capable of high reductions, probably above 90 percent if a sufficient number of windows and vents is opened. High reductions result because natural ventilation both reduces the flow of soil gas into the house, by neutralizing the pressure difference between indoor and out, and dilutes any radon in the indoor air with outdoor air.

Forced Ventilation

Rather than relying on natural air movement, forced air fans can be used to provide a controlled amount of forced ventilation. For example, a fan could be installed to continuously blow fresh air

into the house through the existing central forced-air heating, ducting, and supply registers with windows and doors remaining closed and radon blower can exhaust the radon from the ground underneath your basement to the outside before letting the radon flow throughout your home. Alternatively, fans could blow air into the house through protected intakes through the sides of the house, or could be mounted in windows. A fan could also be installed to blow outdoor air into a crawl space. Using fans to maintain a desired air exchange rate independent of weather conditions.

Heat Recovery Ventilation (HRV)

Replaces radon-laden indoor air with outdoor air. A device called a heat recovery ventilator (sometimes referred to as an "air-to-air Heat exchanger") uses the heat in the air being exhausted to warm the incoming air. In an air-conditioned house in warm weather, the process is reversed: The air being exhausted is used to cool the incoming air. This saves between 50 and 80 percent of the warmth (or coolness) that would be lost in an equivalent ventilation system without the device. Heat recovery ventilators are usually cost-effective only if operated during cold weather or in hot weather if the indoor versus outdoor temperature differences is large. At other times, the same amount of ventilation and radon removal can be achieved by simply opening windows.

Sealing Cracks and Openings

Radon is an inert gas that can pass through any opening Exposed earth in basement floors, joints between basement floors and walls including perimeter, cold-rooms, storage areas, utility pipes, drain areas, sumps, and the like, as well as in crawl spaces-if often a major entry point for radon. These openings should be enlarged enough to allow filling with compatible, gas-proof, non-shrinking sealants. A water trap should be installed in floor drains connecting to drainage or weeping-tile systems. Water traps allow water that collects on basement floors to drain away but greatly reduce or entirely eliminate entry of soil gas, including radon. Sealing the cracks limits the flow of radon into your home, thereby making other radon reduction techniques more effective and cost-efficient. It also reduces the loss of conditioned air. Sealing such cracks and openings is an important preliminary step while other methods are used for total effectiveness.

For houses with marginal radon problems, sealing alone may be sufficient but in cases of extensive work, it may prove to be expensive but it will be worth the cost. Sealing cracks and openings in the foundation is a basic part of most approaches to radon reduction,

Home Pressurization

Home or room pressurization uses a fan to blow air into the basement, or living area from either upstairs or outdoors. This method prevent radon from entering your home by keeping the lower part of the house which is in contact with the soil at a pressure higher than that of the air in the soil. This prevents soil gas diffusion. In order to maintain enough pressure to keep radon out, the doors and windows at the places level must not be left open, except for normal entry and exit.

The most common application of this method is to blow upstairs air into the basement; however, in some homes, blowing upstairs air into a crawl space may also be applicable.

COST AND HIRING INDOOR AIR QUALITY EXPERTS

How much does it cost to reduce radon in an existing home?

The cost of making repairs to reduce radon is determined by the size and design of your home and age of the house, material used, how high your initial radon level, system operation, and your foundation type etc. Most homes can be fixed for about the same cost as other common home repairs, like painting or having a new hot water heater installed.

Who should I hire to correct a radon problem?

It is wise to get more than one estimate, to ask for references, visit their website to see what people had to say about the quality of their work. Ask the contractor if they hold a professional proficiency or certification credential, and if they follow industry consensus. Lowering high radon levels requires technical knowledge and special skills hence it is advisable to let the professional handle it. You should contract a company that specializes in indoor air quality and certified in fixing radon problem. You can also check with your state radon office to see if there are state requirements that your contractor must meet.

APPENDIX A

Basic Installation Checklist Your Contractor Should Meet When Installing a Radon Reduction System

Verified	Basic Installation Requirements
	Radon reduction systems must be clearly labeled. This will avoid accidental changes to the system that could disrupt its function.
	The exhaust pipes of soil suction systems must vent above the surface of the roof and 10 feet or more above the ground, and must be at least 10 feet away from windows, doors, or other openings that could allow the radon to reenter the home, if the exhaust pipes do not vent at least 2 feet above these openings.
	The exhaust fan must not be located in or below a livable area. For instance, it should be installed in unconditioned space.
	If installing an exhaust fan outside, the contractor must install a fan that meets local building codes for exterior use.
	Electrical connections of all active radon reduction systems must be installed according to local electrical codes.
	A warning device must be installed to alert you if an active system stops working properly. Examples of system failure warning devices are: a liquid gauge, a sound alarm, a light indicator, and a dial, or needle display, gauge. The warning device must be placed where it can be seen or heard easily. Your contractor should check that the warning device works. Later on, if your monitor shows that the system is not working properly, call a contractor to have it checked.
	A post-mitigation radon test should be done within 30 days of system installation, but no sooner than 24 hours after your system is in operation with the fan on, if it has one. The contractor may perform a post-mitigation test to check his work and the initial effectiveness of the system; however, it is recommended that you also get an independent follow-up radon measurement. Having an independent tester perform the test, or conducting the measurement yourself, will eliminate any potential conflict of interest. To test the system's effectiveness, a two- to seven-day measurement is recommended. Test conditions: windows and doors must be closed 12 hours before and during the test, except for normal entry and exit.
	Make sure your contractor completely explains your radon reduction system, demonstrates how it operates and explains how to maintain it. Ask for written operating and maintenance instructions and copies of any warranties.