

UNDERSTANDING RADON

by
G. Thomas Martin



We realize most people find it difficult to understand radon; a colorless, odorless, inert radioactive gas. You cannot see it, smell it, or feel it; yet we cannot completely avoid breathing radon. There is about 0.35 pCi/L of radon in the outside air we breathe. Understanding the risks associated with radiation exposure is even more perplexing. I hope reading this article, will enable you to make an informed decision about the radon levels measured in your house.

TABLE OF CONTENTS

Section

- [1...Where Does Radon Come From?](#)
- [2...How Does Radon Get Into The House?](#)
- [3...What About Radon in Well Water?](#)
- [4...What About Radon in City Water?](#)
- [5...What Is the Risk of Radon Exposure?](#)
- [6...How Serious a Risk is Radon?](#)
- [7...Do Scientists Agree that Radon is Dangerous to Breathe?](#)
- [8...Who Do I Believe?](#)
- [9...What Should I Do About The Levels of Radon in My Home?](#)
- [10...What Should I Look at in Deciding Whether to Mitigate or Not?](#)
- [11...What if, I Decide to Reduce the Radon Levels in My Home?](#)
- [12...What Should I Look for in a Properly Installed System?](#)
- [13...Who Should Pay to Get the Radon Reduced?](#)
- [14...How Much Does it Cost to Operate These Systems?](#)
- [15...How Can I Learn More About Radon?](#)

1. WHERE DOES RADON COME FROM?

Radon comes from the natural radioactive decay of radium and uranium found in the soil beneath the house. The amount of radon in the soil depends on complex soil chemistry, that varies from one house to the next. Radon levels in the soil range from a few hundred to several

thousands of pCi/L. The amount of radon that escapes from the soil to enter the house depends on the weather, soil porosity, soil moisture, and the suction within the house.

2. HOW DOES RADON GET INTO THE HOUSE?

Houses act like large chimneys. As the air in the house warms, it rises to leak out the attic openings and around the upper floor windows. This creates a small suction at the lowest level of the house, pulling the radon out of the soil and into the house. You can test this on a cold day by opening a top floor window an inch. You will notice warm air from the house rushing out that opening; yet, if you open a basement window an inch, you will feel the cold outside air rushing in. This suction is what pulls the radon out of the soil and into the house. You might think caulking the cracks and the openings in the basement floor will stop the radon from entering the house. However, scientific studies show, it only takes enough unsealed cracks or pin holes in the caulking to equal a hole 1/2" in diameter to let all the radon in. It is unlikely that caulking the accessible cracks and joints will permanently seal the openings radon needs to enter the house. The radon levels will still likely remain unchanged.

Fortunately, there are other extremely effective means of keeping radon out of your home. Throughout the country, several million people have already tested for radon. Some houses tested as high as 2,000-3,000 pCi/L; yet, there hasn't been one house that could not mitigate to an acceptable level. Mitigation usually costs between \$500-\$1500.

3. WHAT ABOUT RADON IN WELL WATER?

Underground well water can transport the radon from the soil into the house, when taking a shower, doing laundry, or washing dishes. The EPA says it takes about 10,000 pCi/L of radon in water to contribute 1.0 pCi/L of radon in air throughout the house. The ratio of radon in water to radon in bathroom air while showering can be much higher, typically from 100 to 1; to about 300 to 1. The average Colorado well tests about 3,000 pCi/L with one well testing more than 3,000,000 pCi/L.

4. WHAT ABOUT RADON IN CITY WATER?

If your water comes from a municipal reservoir supply, you need not worry about radon in the water. When radon in water is stored in a reservoir for more than 30 days, the radon decays away to practically nothing. Every 3.825 days half the radon disappears through natural radioactive decay.

5. WHAT IS THE RISK OF RADON EXPOSURE?

Scientists believe radon exposure is the second leading cause of lung cancer. When radon decays, it shoots off alpha particles. These are small, heavy, electrically charged, sub-atomic particles consisting of two protons and two neutrons. If an alpha particle strikes the chromosomes in a lung cell, it could alter the way that cell reproduces. Our bodies immune system should recognize and destroy these mutant cells before they can multiply over the next 10 to 20 years into a recognizable cancerous growth.

Some peoples immune system is better than others. Because of these inherent differences,

radon doesn't affect everyone the same.

6. HOW SERIOUS A RISK IS RADON?

According to the following EPA radon risk chart, radon is a serious health problem.

If 1,000 people were exposed to this level over a life time who are:

Annual Radon Level....	Smokers.....	Never Smokers
20 pCi/L....	14% or 135 people.....	0.8% or 8 people could get lung cancer
10 pCi/L.....	7% or 71 people.....	0.4% or 4 people could get lung cancer
4 pCi/L.....	3% or 29 people.....	0.2% or 2 people could get lung cancer
2 pCi/L.....	2% or 15 people.....	0.1% or 1 person could get lung cancer

7. DO SCIENTISTS AGREE THAT RADON IS DANGEROUS TO BREATHE?

There is little disagreement that breathing the hundreds of pCi/L of radon that caused thousands of uranium miners to get fatal lung cancer is definitely harmful. Many scientists disagree with the EPA about what the level of radon should be before it should be reduced.

The EPA studied the lung cancer risk of uranium miners exposed to 400 pCi/L. They assume the risk of a home owner exposed to 4 pCi/L to be one hundredth as much. Based on this assumption, the EPA guideline level of 4 pCi/L represents a much greater risk than allowed for other environmental pollutants.

Other scientists have tested more than 70,000 homes across the United States. This study shows the counties with the highest average radon levels had the lowest incidence of cancer. Perhaps, breathing the low levels of radon found in the home environment, might not be harmful. Neither study fully accounts for all the different confounding factors that can cause cancer. The truth probably lies somewhere between these two theories.

8. WHO DO I BELIEVE?

In 1988 the United States Congress passed legislation, directing the EPA to work toward a long term national goal, "The air within buildings in the United States should be as free of radon as the ambient air outside of buildings." Real estate agents are hired and paid by the sellers, to represent the sellers economic interests, in the sale of their house. Understandably, you might get two completely different opinions about radon, depending whether you ask the EPA, or your real estate agent. Because you have hired us to test for radon, and explain the test results. We will offer our opinion on the subject, and guidance on a prudent course of action.

9. WHAT SHOULD I DO ABOUT THE LEVELS OF RADON IN MY HOME?

The following represents our opinion, based on our understanding of the radon issue from several sources.

- A... If the house tests above 20 pCi/L most experts agree it is prudent to install a system that can permanently reduce your families exposure to radon.
- B... If the house tests below 4 pCi/L most experts agree that there is a relatively low probability of significant health risk at this low level of exposure. However, we recommend retesting the radon levels once you move in, to verify this low reading. Industry surveys show that up to 30% of the radon tests in real estate transactions are subject to some ventilation. **LET THE BUYER BEWARE.** We once tested a house, that measured 168 pCi/L in a child's bedroom. The selling agent ordered a retest by a tester known to test on the second floor with the windows open. He told my clients the house only measured 3.5 pCi/L and they didn't have a radon problem. Although he never gave my clients a written report stating this.
- C... If the house tests between 4 and 20 pCi/L there is no need for immediate panic, but you will have to make some difficult decisions. About 50% of the houses we test fall in this gray area. The average Colorado home measures 5.9 pCi/L. The national average is 1.5 pCi/L and outside air measures about 0.35 pCi/L. The closer to 4 or 20 pCi/L the easier the decision should be. The most difficult decisions are in the 10 to 12 pCi/L range.

10. WHAT OTHER FACTORS SHOULD I LOOK AT IN DECIDING WHETHER TO MITIGATE OR NOT?

Cigarette smokers should keep their exposure to radon as low as possible. Smokers have eight times the risk from radon as non smokers. Smokers who reduce their radon exposure from 6 pCi/L to 2 pCi/L, will receive as much beneficial risk reduction as the non smoker who reduces their exposure from 34 pCi/L to 2 pCi/L.

If the house was tested in an infrequently used basement. It may have measured a radon level that is two to three times the actual level you are exposed to, spending most of your time upstairs.

You can reduce your families annual radon exposure about 40%, if you open the basement windows a few inches to allow cross ventilation from May till September. This may be appropriate for slightly elevated houses that don't need year round reductions.

People with young children should be more concerned with the possible consequences of radon exposure 20 years from now than someone in their late sixties or seventies.

Families with a hereditary predisposition of cancer should be more concerned about radon exposure than families who don't have any history of cancer.

If you work for a company that might transfer you in the future, our employer probably will hire a relocation company to purchase your home. Today, most relocation companies insist that the house test below 4 pCi/L before they will buy it. Some buyers have adopted this position; anything below 4 pCi/L is fine while anything above 4 pCi/L is unacceptable. This unfortunate

misinterpretation of EPA guidance, could cause you to pay for a radon mitigation system when selling your home. At this time your family would not receive any benefit from the radon reductions.

The decision, What to do about radon? is a personal choice that only you can make. Some people feel it is best to reduce as many of life's risks as they can. Other people feel the money spent installing and operating a radon mitigation system on a moderately elevated home could be put to better use, having regular family medical and dental check ups, or making other safety improvements in their home.

11. WHAT IF, I DECIDE TO REDUCE THE RADON LEVELS IN MY HOME?

If you feel the radon levels are high enough to justify installing a radon mitigation system, we recommend installing a good quality, durable, energy efficient system. All our radon reports testing above 4 pCi/L, include detailed specifications, describing the installation and materials needed to achieve this. It is best to have all mitigation contractors bid on installing the system exactly as specified in this report. All too often the sellers or their agents end up deciding, who will do the work, and how it will be done. Their main concern is that it be installed as cheaply as possible to get the radon levels down below 4 pCi/L for the retest. Often they have the contractor who installed the system, do the retesting to verify it is below 4 pCi/L, before he gets paid. This could create a possible conflict of interest.

12. WHAT SHOULD I LOOK FOR IN A PROPERLY INSTALLED SYSTEM?

- A... Install all fans outside the living area of the house, so all interior piping is under negative pressure. Many contractors find it cheaper and easier to put the fan in the basement near an existing electrical outlet. Often these fans and piping develop leaks. This could allow the system to start pulling the thousands of pCi/L of radon out of the ground and blow it into the basement or crawlspace; thus making the radon levels in the house higher than they were originally.
- B... The high radon concentration air blowing from the fan should discharge above the roof, or at least ten feet from any doors, windows or decks. No one wants to breathe hundreds or thousands of pCi/L coming from these fans.
- C... Dig the suction pit under the floor as large as possible, or make sure it intersects the void beneath a grade-beam foundation.
- D... Seal crawlspaces with a gas membrane, made of cross-laminated polyethylene, placed between two layers of 30 lb. tar paper, to protect it from damage. Make sure the membrane is tightly fastened to the foundation walls, with plywood strips and sealed with industrial grade urethane caulking. It is cheaper to install one layer of regular polyethylene directly over the soil, and fasten it to the walls with duct tape, glue or caulking. This method will reduce the radon levels, but the single layer of regular polyethylene gets torn when someone crawls across it. Duct tape or glue usually falls off the wall within a month or so. When this happens, the system will still keep the radon levels down, but the fan will start pulling large amounts of heated air out of the house. The added cold air could subject the crawlspace plumbing to freezing and increase the cost of heating your home as much as \$200.00 to \$300.00 a year. This unnecessary loss

of heat could add up to \$20,000.00 to \$30,000.00 over the hundred year life of the house. The money saved on the initial installation might not be such a bargain after all.

- E... Caulk the large cracks and joints in the concrete floor slab to prevent unnecessary heat loss.
- F... Install a manometer or warning device to alert you if anything goes wrong with the system.
- G... Permanently label all systems, with the contractors name, phone number, operation and maintenance instructions and a place to note all radon test results. The people living in the house 15 to 75 years from now will need to know what this system is, and why it is needed.

13. WHO SHOULD PAY TO GET THE RADON REDUCED?

If you are buying a house, this is strictly a matter of negotiation for which there are no hard and fast rules. Some people will choose to follow one of the GOLDEN RULES, Do unto others as you would have them do unto you, or **He who has the gold makes the rules**. No matter who ends up paying for the system, it is in your best interest that you be the one to select the contractor and specify how the work will be done. If you leave these decisions to others you might not end up with the type of system you want to have. Most contractors will give you a written bid of exactly how much the system will cost when you have them install it. Do not worry if the radon can be successfully reduced; this is a sure thing. In most cases, contractors will guarantee that they will reduce the levels to below 4 pCi/L. Properly installed systems usually get the radon down to below 2 pCi/L and sometimes even below 1 pCi/L. We have tested several houses that originally measured more than 100 pCi/L, that where mitigated to levels below 2 pCi/L.

14. HOW MUCH DOES IT COST TO OPERATE THESE SYSTEMS?

Most systems are powered by a 90 watt fan that use less than \$52.00 worth of electricity a year. These fans should last about 14.7 years and presently cost \$125.00 to replace. If the system is properly installed and well sealed, there shouldn't be any noticeable increases in the heating bills. However, if the cracks and joints in a finished basement cannot be sealed, the heating cost might increase slightly. Check this on a cold day by feeling the amount of warm air blowing from the fan.

15. HOW CAN I LEARN MORE ABOUT RADON?

The EPA's hotline at 1 800-SOS-RADON will be happy to answer your questions and send you their pamphlets about radon. They can send you a list of radon contractors and tell you how to get their technical publications about radon and radon mitigation.

You can call the local Department of Health.

[EPA's Position on Radon](#)

[EPA'S Radon Publications](#)

Your local library might have some of the following books.

- *The Indoor Radon Problem...Douglas E. Brookins*
 - *Radon The Invisible Threat..Michael Lafavore*
 - *Radon a Homeowner's Guide (Consumer Reports Books)...Bernard Cohen*
 - *Radon and its Decay Products...William W. Nazaroff & Anthony V. Niro, Jr.*
 - *Radiation Hormesis.....T.D. Luckey CRC Press*
 - *Health Risks of Radon and Other Internally Deposited Alpha-Emitters...National Academy Press*
 - *Health Physics....Pergamon Press The Radiation Protection Journal*
 - *Radon, Radium and Uranium in Drinking Water...Richard Cothorn & Paul A. Rebers*
 - *Radon in Ground Water...Barbara Graves*
-

Our instruments are calibrated by [de-emanating National Bureau of Standard's Radium solutions](#). You may review the results of these blind intercomparison tests and our quality assurance program at any time.

*Feel free to download or print this article for personal use. [Home](#)
[Page](#)*

Professional Home Inspections, Inc.

gtmartin@discoverit.com This was created on 1/27/95 and last modified on 1/27/2000 by [professional home inspections, inc.](#) © Copyright 1995 by discoverit.com, inc. all rights reserved.