

A Non-Technical Explanation of Radon Gas
By Dr. Jim Burkhart

First, let me make clear that I am the director of the Radon Measurements Lab at the University of Colorado in Colorado Springs. I am telling you this at the beginning of this essay in order to disclose any potential conflict of interest. You can judge for yourself if I am being accurate in the assessment of radon in El Paso County, and its surroundings. I think I am. There are many trustworthy internet sites you can visit, like the EPA or the American Lung Association, in order to verify my statements.

What is radon?

Radon is a gas that comes from the radioactive decay of radium. Radium, itself, comes from the radioactive decay of uranium. So, you could say that all radon comes from uranium. Almost all uranium in this area is in the ground and/or bedrock beneath our feet. Therefore, radon continuously “seeps” up from the ground and into the air, or, into the structures that are built on that ground.

Does El Paso County have more radon than other areas?

The uranium in our area has been here for eons. In fact, we have more than twice the amount of uranium per gram of soil than the average in the U.S., 10 parts per billion compared to 1 to 5 parts per billion elsewhere. Actually, most of the state (Colorado) is higher in radon than the national average because of many factors, the most important being the amount of granite in the Rocky Mountains and in the soils and rocks derived from the Rockies because granite is relatively high in uranium. For example, the average house in Colorado Springs has a radon concentration around 6 picocuries per liter (a measure of radioactivity within a liter of air) where the national average is just over 1 picocurie per liter (pronounced peeko-curries-per-liter and abbreviated pCi/L). Houses in the foothills are typically even higher, and, houses up in the mountains (Woodland Park and Divide, for example) are higher yet. Higher than normal levels have also been measured north, south and east of Colorado Springs with just a few examples being Monument, Security, Pueblo, Castle Rock, Peyton and Calhan.

Where are the highest radon levels in Colorado Springs?

Every area of Colorado Springs has been tested and “high” levels have been found in every area. Our Lab has measured over 55,000 homes in, and around, Colorado Springs, and has found no area which has low radon for all of its houses. However, if you live along the foothills, you probably will find your radon levels to be quite above the EPA recommended “action level” of 4.0 pCi/L. Residents of, for example, Peregrine, Mountain Shadows, the Mesa, the Broadmoor, Broadmoor Heights, and houses in the shadow of Cheyenne Mountain would be expected to have radon levels twice, or more, the EPA “action level” of 4.0 pCi/L.

Why does the EPA consider radon gas a hazard?

The inhalation of radon gas and the radioactive particles (radon decay products) that come from radon are known to cause lung cancer. The United States Environmental Health Association has been concerned about the excess lung cancers caused by radon gas in mine workers since the 70's. (The epidemiologic data regarding radiation risk to miners is described in the BEIR VI Report (NAS, 2004; Lubin 1997)). At about that same time, the EPA was involved in "cleaning up" radon in houses that were built out of mine tailings containing uranium (some of them right here in Colorado on the western slope). Then, in the early 80's the EPA attention was shifted to radon in homes. From that time to the present, the EPA has continued to refine its estimates of the amount of lung cancer caused primarily by the inhalation of radon gas in homes. Early on, it decided on an "action level" of 4.0 pCi/L based on a mixture of science, medicine and plain old economics (the cost of fixing a home). Interestingly, the "action level" has gained support, as the amount of scientific and medical research has increased, confirming the EPA's original "guesstimate". As an example, based on the results of large North American (Krewski, 2006) and European (Darby, 2005) pooling (pooling means that many individual studies were combined), on January 13, 2005, the US Surgeon General issued a National Health Advisory for Residential Radon encouraging the public to test for indoor radon and to take action if the radon level in the home is 4 pCi/L, or greater (US Surgeon General, 2005). So, although it is not, strictly speaking, correct to say that 4.0 pCi/L, or above, is bad for you and that radon levels below 4.0 pCi/L are OK, nonetheless, the 4.0 pCi/L "action level" is used by many people, including home builders and realtors, as a decision point. For those of you who would like a more detailed risk assessment for getting lung cancer, based on different radon levels and your own smoking habits, I would recommend going on the EPA.gov web site and reading the Citizen's Guide to Radon, page 12.

How Do You Test Your House for Radon?

You can purchase your own radon test for about 25 bucks, and that includes the lab analysis and the report. Better yet, you can have your house tested for radon by a local home inspector or radon tester. That is more expensive, but it is especially important to use a third party, like a home inspector or radon tester, if you are selling or buying a house. Radon tests come in different configurations and prices but I am especially confident in the performance of charcoal canister tests because I have a lot of experience with them and have seen their accuracy hold up over many years of running the radon lab. Of course, I run a charcoal canister lab so I may be biased. However, any radon test that is currently approved by the National Environmental Health Association Radon Proficiency Program, or has been grandfathered into that program, should work just fine. I personally do not recommend purchasing a radon test from a hardware store simply because the quality control is not monitored in a hardware store environment.

The test is typically for 48 hours and the house windows and doors should be shut for the duration of the test and for 12 hours before the test begins. Place the test on the main living floor, in a bedroom, up about table height, and leave it alone for the duration of the test. Please read carefully the directions that come with the test as there are so many different tests available and they all have their own unique directions. If you are buying the home, or selling your own home, and a radon test is being conducted, you will find that the test is typically not placed on the main living floor but, rather, in the basement (if the house has a basement). That is correct. The testing protocols actually specify the lower location for a real estate-based test. And, depending upon the test device, you may find that two tests are placed simultaneously (within 4 inches of each other) for a real estate-based test.

What Do You Do When You Get the Test Results?

This is when the “action level” becomes important. Typically, if you are selling the home and the radon result is 4.0 pCi/L or higher, there will be some kind of discussion about mitigating the home to bring the level below 4.0 pCi/L. Whether the costs of mitigation are borne by the buyer or the seller is, at present, open to negotiation and how the contract for the sale of the house was written. Currently, Colorado law does not require a radon test or mitigation at the time of sale. However, that may change.

If you measured your own radon, or had a professional do it for you, **but you are not selling your home**, you would confirm any initial radon reading that was above 4.0 pCi/L before calling a mitigation company. So, that means you would have two radon tests done, if the initial reading was above 4.0 pCi/L, if the test is not a real estate-based test. Typically, the average of the two tests is used to determine whether mitigation would be recommended with an average of 4.0 pCi/L, or higher, suggesting that mitigation is called for.

How is a House Mitigated for Radon?

Every house is different, but houses that are built on a slab on grade or with a basement are mitigated using a fan system that extracts the radon from below the house and exhausts the radon above the house so that the radon can mix with the fresh, outside, air and by-pass the living envelope of the house itself. This kind of mitigation can usually be done by a professional in less than one day. It will require a small hole to be drilled or sawed into your basement or slab-on-grade floor and some exhaust pipes (usually 4 inch PVC) run up inside, or outside, the house.

For those of you with a crawl space home, the mitigation is a little more complicated because a plastic membrane has to be put down in the crawl space first, and then the exhaust system is installed as if the membrane were the basement floor. The additional labor of putting down an air tight membrane does cost more, of course.

It is even possible to use an existing drain tile water control system to mitigate a house. Further, in some cases, very few, however, air-to-air heat exchangers (also called heat-recovery ventilation systems) are used when the more standard mitigation systems outlined above are not practical.

The costs of a mitigation system vary so be sure to have your house looked at by two or three mitigators, each giving you their bid. I will say that the cost of mitigation in our area is very reasonable because of the competition. It is not unusual to have a house mitigated with a permanent radon reduction system for less than \$1500. Quite a bargain! You can get a list of mitigation companies from the yellow pages. I wouldn't try to save a few bucks by using a company out of Denver because mitigations are usually guaranteed and that may require a call-back. Get someone local.

I Heard On the Radio That Radon Was Not Dangerous. Is That True?

There are some well-respected scientists and their followers who are not convinced that radon is a hazard at the levels it is found in houses in the U.S.. Dr. Bernard Cohen, from the University of Pittsburgh, for example, is one well-known spokesperson for the "anti-radon" coalition. I respect Dr. Cohen very much and have read all of his work. However, I believe he misses the point in his research and in his pronouncements as he takes the position that no one has proven a "linear, no threshold" relationship for radon dose and lung cancer incidence (although he accepts a linear, no threshold relationship between alpha particle "hits" and resultant cell damage). You see, whether there is a linear, no threshold" relationship or not is beside the point, in my view. The real point is that the afore-mentioned American and European studies do not rest upon a linear, no threshold hypothesis. They simply show that radon concentrations in homes are correlated to lung cancer incidence and it is correlated in a linear fashion. In other words, the so called linear, no threshold, model is not used as a hypothesis, but is part of the conclusion.

By the way, the EPA is not alone in pointing out the hazards of radon in homes. Just a partial list of other supporters would include the National Academy of Sciences, the American Cancer Society, the American Lung Association, the Conference on Radiation Control Protection Directors (CRCPD) and our own state of Colorado Health department (CDPHE).

So, if someone tells you that radon is overblown, check their credentials. See if they are using old data (pre-1997) and ask them why they are so opposed to you spending \$25 on a radon test to ensure the safety of you and your family.

Dr. Burkhart is a professor of physics and the chair of the physics department at the University of Colorado-Colorado Springs. He is also, as he says above, the director of the radon lab at the university (719-255-3584). For a small sample of his recent articles in radon please visit www.uccs.edu/~physics/faculty.html and click on "Publications and Presentations".

References

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