RADON

This is an overview of the subject of radon, as one of the many sources of indoor air pollution. The relative importance of any single source depends on how much of a given pollutant it emits and how hazardous those emissions are. The scientific community continues to conduct research to refine our understanding of radon. If high levels of radon are discovered in your home (>4.0 picocuries per liter), you should immediately consult with a radon mitigation specialist recommended by the National Environmental Health Association (NEHA). The NEHA (the accepted listing body in the Radon Industry) and National Radon Safety Board (NRSB) run the Radon Proficiency Program. The preferred and accepted way of fixing reducing radon levels is active sub-slab depressurization.

WHAT IS IT?

Radon is a radioactive decay by-product of uranium and radium, elements that are naturally present in rock and soil. If allowed to decay for an infinite length of time, literally thousands of years, uranium will simply turn into non-radioactive lead. During the course of its decay, it will emit radon gas. Radon is a colorless, odorless, tasteless gas that, by itself, is not a concern. However, the radioactive by-products of the radon gas are highly charged particles that adhere to dust and other fine matter that can be inhaled by people. They are often referred to as radon daughters, radon progeny or alpha particles. In sufficient concentration, inhaling radon can lead to lung cancer. We all breathe radon in the outside air at .4 pCi/L. The average indoor level is 1.3 pCi/L. Every home will have a radon level, but ensuring a very low amount is important.

WHERE DOES IT COME FROM?

Radon gas enters our houses through two primary paths. The first is the migration of gases out of the soil directly into the air within our homes. The second is a home's water supply that passes through potential radon sources such as granite.

Radon in the air is of considerably more concern than radon in water. We believe all houses should be tested for radon in air. Radon in water is typically not a problem with public water supplies, but if you have tested for radon in air and have elevated radon levels and a private well, have the well checked for radon.

Typically, radon (naturally present in the soil gas under the foundation) travels from the soil into our homes through cracks and holes in the foundation, walls and construction joints, around service pipes, floor and wall cavities, and in well water. In any closed structure, the air pressure is slightly less in the lowest level mostly due to the stack effect, which occurs when warm air rises up and diffuses through the roof, and partly because mechanical systems use interior air and move it outside. In the process, radon gets sucked in like a vacuum through whichever entry route exists, which can be as little as a normal hairline crack in the foundation. The radon is trapped inside our homes and builds up. Any home can have a radon problem (new/old, tight/drafty, slab/basement, etc.). Elevated radon levels have been documented in all states. The most vulnerable houses, however, are those with stone or block foundations, exposed rock ledge in the basement, or dirt floors in the basement or crawl space. While all these types of structures provide more opportunity for radon to enter the home, there are not any houses that are more susceptible to elevated levels.

WHAT LEVEL IS SERIOUS?

Radon is measured in picocuries per liter (pCi/L), which is best accepted simply as a measure of radioactivity. Currently, most estimates indicate that the average level of radon in all homes throughout the country is probably about 1.3 pCi/L. The average level of radon outside our homes in the general atmosphere is probably about 0.4 pCi/L.

The EPA has defined an "action level" for radon of 4.0 pCi/L. It should be noted that no safe level has been determined and these levels are as stated in the EPA publication Home Buyer's and Seller's Guide to Radon[1]

WHAT TEST PROCEDURES ARE AVAILABLE?

Special testing equipment is needed to detect this odorless, colorless gas. Radon test kits are categorized as "passive" or "active" and "short term" or "long term."

Passive testing devices (i.e. charcoal canisters) do not require electrical power to function, can be purchased by mail or at a hardware store, and are mailed to a lab to receive results. These are usually short-term tests. Active testing devices (i.e. continuous radon monitors) require electrical power. They continuously measure and record data over a longer period. Active devices are available from a qualified laboratory that would also produce the results. Both are safe to handle.

Short-term tests remain in a home from two to 90 days (most typically 48 to 72 hours). These tests include alpha track detectors, charcoal canisters, charcoal liquid scintillation detectors, electret ion chambers (passive), and continuous monitors (active). Long-term tests remain in the home for more than 90 days (sometimes six months or more). Unlike a one-time sample, long-term tests provide more accurate data regarding the average level of radon in the house. Alpha track and electret ion chamber detectors are the most common types of this method of testing.

Precautions should be taken to avoid interference during the testing period (maintain closed-house conditions, do not disturb the test device, etc.).

Some test equipment on the market will report immediate results from a "grab sample." This involves simply taking a sample of the air for a few minutes. The test will then produce an immediate indication of the amount of radon present. Results of grab sampling are influenced greatly by conditions that exist in the building during and for up to 12 hours prior to the measurement, therefore such testing is not appropriate for homes, schools, or workplaces when the results are being provided for remediation to a homeowner or building official.

Different test equipment (i.e. continuous electronic radon monitor) is available that will monitor radon levels for an extended period (a week or more) and report on the level of radon hour by hour. This device can produce very useful information by indicating the peaks, valleys, and trends of radon presence. This equipment is quite expensive and typically available for lease for residential testing.

Whether you use a short or long-term test, use a device and testing company that is state certified, and/or is listed in EPA's Radon Measurement Proficiency (RMP) Program. We

recommend visiting your state government's environmental Web site for more information about state certification of radon testing services. Not all states have such requirements.

No one sample should be relied on as conclusive evidence of the radon levels in a home. It should be kept in mind that, especially with a short-term test, the findings are based only on a brief sampling in the house. Sometimes short-term tests are less definitive. Many studies that have been done indicate that radon levels in a house can vary significantly from day to day, hour to hour, and season to season. Structural changes, alterations, or changes in the heating, ventilation, and air condition may affect radon levels. Results will be more definitive if two samples are taken, at either the same time or one immediately following the first.

EPA RECOMMENDED TESTING OPTIONS (from Home Buyer's and Seller's Guide to Radon[1])

SHORT-TERM TESTING OPTIONS	WHAT TO DO NEXT
Passive: Take two short-term tests at the same time in the same location for at least 48 hours.	Fix the home if the average of two tests is 4 pCi/L or more.
Or	
Take an initial short-term test for at least 48 hours. After the first test has been completed, take a follow-up short-term test for at least 48 hours.	Fix the home if the average of two tests is 4 pCi/L or more.
Active: Test the home with a continuous monitor for at least 48 hours.	Fix the home if the average radon level is 4 pCi/L or more.

During the Test:

- Maintain closed-house conditions during the entire duration of a short-term test, especially for tests shorter than one week in length.
- Operate the home's heating and cooling systems normally.
- Do not disturb the test device at any time during the test.

TEST LOCATION

The EPA and State laws (in most states) detail specific requirements for radon testing in real estate transactions. Two test devices (or one device, when using a single electronic continuous radon monitor) should be placed in the lowest livable area. The intent, as explained in the EPA publication Home Buyer's and Seller's Guide to Radon[1], is to provide an extra degree of assurance with regard to the accuracy of the test, realizing that only one brief opportunity to test may be the basis for a decision to buy a piece of real estate. While an additional test device placed on an upper floor of a house will provide more information, it should not compromise the

basic testing protocol, i.e. two test devices in the lowest livable level, nor should it influence the interpretation of those results.

The American Association of Radon Scientists and Technologists (AARST) specifically notes that the EPA standard should not be compromised by doing an additional test on an upper level. That additional test should be over and above the two test devices at the lowest livable level.

The EPA does suggest that the actual location of the radon test be negotiable between the buyer and seller, subscribing to the guidelines offered in their publication, Home Buyer's and Seller's Guide to Radon[1]. In other words, it may be decided (by agreement between the buyer and seller) that a test be conducted on a level other than the currently lowest livable level.

When the time pressures of the real estate process are not a consideration or the most accurate information is needed, the preference of the EPA continues to be a more extended test.

INTERPRETATION OF TEST RESULTS

4.0 pCi/L has been established as a level that most homes can achieve with appropriate mitigation. 4.0 pCi/L should not be considered an indication of what level is safe.

AARST reinforces its position that 4.0 pCi/L should not be considered a safe level or an acceptable exposure level. If an elevated radon level is found (> 4pCi/L), the home should be fixed. If you are in the process of purchasing a home, you and the seller should discuss the timing and costs of radon reduction. One approach may be to purchase the home and then proceed with improvements, or perhaps an escrow account could be established with the seller to correct the problem.

WHAT IS THE HEALTH RISK?

Unfortunately, many articles have appeared in newspapers and magazines that have taken a "the sky is falling" approach to the radon problem. We agree that it is a significant issue that requires attention. We do not, however, agree that it is the basis for such headlines as "THREE OUT OF EVERY TEN HOMES WILL KILL YOU."

Attached is the "Risk" table from the current EPA publication, Home Buyer's and Seller's Guide to Radon[1]. Please note the reference "Exposed Over a Lifetime." This is an important perspective.

To date, most studies indicate that continued exposure to radon levels of approximately 10 pCi/L is roughly equivalent to the degree of risk of lung cancer resulting from smoking one pack of cigarettes a day.

It should be noted that those studies typically define continuous exposure as being 75% of your time for approximately 70 years. In other words, the effects of radon are cumulative. Virtually no hazard exists from brief exposures to even extremely high levels of radon.

In addition, most of those studies have been based on high-level exposures experienced by miners working in uranium mines. Only now are studies being performed that give more accurate information regarding the risk in our homes. Recent studies report that approximately 12% of all lung cancers are linked to radon.

HOW IS IT BEST CONTROLLED?

Fortunately, even significant concentrations of radon in the air are relatively easy to control. There are several excellent documents published by the EPA that discuss these methods in detail. If you wish to pursue this matter, you should obtain copies of them. They are generally available free of charge; http://www.epa.gov/radon/pubs/mitstds.html and http://www.epa.gov/radon/images/buildradonout.pdf

Briefly, the control methods suggested fall into two categories.

First, in existing construction, consider the following:

Seal off the path through which radon is entering. The EPA does not recommend sealing alone as a fix. If an entry source has already been identified, all it takes is a new entry route that could be as minor as a normal hairline crack in the foundation or slab.

Provide positive ventilation into the basement of the house, using a heat exchanger or ventilation fan. Keep in mind that positive ventilation is important since an exhaust fan that creates negative air pressure in the house might actually encourage additional radon to enter. The preferred method is sub-slab suction (sub-slab depressurization). These systems prevent radon gas from entering the home from below the concrete floor and from outside the foundation. This will typically reduce radon 80-99% and works best if air can move easily in the material under the slab.

Second, in new construction, consider the following:

If the building is yet to be built, ventilation systems can be installed under and around the foundation (sub-slab ventilation) to intercept the radon gas before it enters the structure. The following are the basic elements of a radon-resistant system:

1. Gas-Permeable Layer: This layer (often a 4-inch layer of clean gravel) is placed beneath the slab or flooring system to allow the soil gas to move freely underneath the house.

2. Plastic Sheeting: Placed on top of the gas-permeable layer and under the slab to prevent the soil gas from entering the home. In a crawlspace, the sheeting is place over the crawlspace floor.

3. Sealing and Caulking.

4. Vent Pipe: A 3 or 4-inch PVC pipe runs from the gas-permeable layer through the house to the roof to safely vent radon and other soil gases to the outside.

5. Junction Boxes: An electrical junction box included in the attic to make the wiring and installation of a possible vent fan easier.

Radon in water is handled differently. The EPA regulates public water supplies; it does not have the authority to regulate private drinking water wells. Radon in well water can increase the indoor radon level. The EPA estimates that indoor radon levels will increase by about 1 pCi/L for every 10,000 pCi/L of radon in water. Currently, the so-called “action level” for radon in

water varies considerably from state to state. Most seem to agree that 20,000 pCi/L in water is an appropriate action level. However, some states and even the Federal Government have lowered or are considering much lower water advisories for private wells (4,000 pCi/L). If you have a private well, you can estimate how much the radon in your water is elevating your indoor radon level by subtracting 1 pCi/L from your indoor radon result for every 10,000 pCi/L of radon that test results indicate is in your water. If most of the radon is not coming from your water, make the necessary home repairs first and then retest your indoor air.

Radon in water can be controlled through filtration (granular activated carbon – GAC) or aeration. Aeration seems to be emerging as the preferred procedure since it is a straightforward, dependable procedure that vents the radon directly to the outside. Point-of-use devices, such as those installed on a tap or under the sink are not effective in reducing radon in water.

WHAT TO WATCH OUT FOR?

There are an increasing number of radon mitigation specialists going into business throughout the United States. The work necessary to cure a radon problem is not complex, sophisticated or magical. It does, however require specific technical knowledge. The EPA recommends that homeowners use a contractor trained to fix radon problems. The EPA's Radon Contractor Proficiency (RCP) Program requires contractors to take training courses and pass an exam before being listed in the EPA's National RCP Report. Ask for references, get more than one quote and insist on a contract. Spending large amounts of money with radon mitigation specialists is often unjustified. Refer to the Consumer's Guide to Radon Reduction [2] for more information.

Companies that provide both radon testing and radon mitigation should be avoided, if possible. Since the reliability of any testing is questionable, to rely on the same company to test and then recommend mitigation procedures leaves you, as a consumer and homeowner, very vulnerable. Testing should be done independently and evaluated objectively before deciding to proceed with any mitigation.

If you have reason to conduct several radon tests for the purpose of studying your home or building over a long period of time, we recommend that you return at least one test device to the lab, unopened, for testing. The results should be zero. If they are not, the testing procedures used by the lab should be questioned. This will obviously raise questions about the reliability of all of their testing.

CONCLUSION

Radon is a hazard in our environment. We know that sufficient cumulative exposure can be hazardous in much the same way as is smoking. Radon is the second leading cause of lung cancer in the United States. We also have determined that it is relatively easy to control once the source and presence is identified.

Prudent and mature handling of the issue is more important than panic.

For more information, contact your local Health Engineering Office or State Environmental Protection Agency (EPA) office.

RADON RISK IF YOU SMOKE

Radon Level	If 1,000 People who smoked were exposed to this level *over a lifetime...*	The risk of cancer from radon exposure compares to...	WHAT TO DO: Stop Smoking and ...
20 pCi/L	About 135 People could get lung cancer	< 100 times the risk of drowning	Fix your home
10 pCi/L	About 71 People could get lung cancer	< 100 times the risk of dying in a home fire	Fix your home
8 pCi/L	About 57 People could get lung cancer	(Left blank by EPA)	Fix your home
4 pCi/L	About 29 People could get lung cancer	< 100 times the risk of dying in an airplane crash	Fix your home
2 pCi/L	About 15 People could get lung cancer	< 2 times the risk of dying in a car crash	Consider fixing between 2 and 4 pCi/L
1.3 pCi/L	About 9 People could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/L is difficult
0.4 pCi/L	About 3 People could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/L is difficult

RADON RISK IF YOU'VE NEVER SMOKED

Radon Level	If 1,000 People who never smoked were exposed to this level *over a lifetime...*	The risk of cancer from radon exposure compares to...	WHAT TO DO:
20 pCi/L	About 8 People could get lung cancer	< The risk of being killed in a violent crime	Fix your home
10 pCi/L	About 4 People could get lung cancer	(Left blank by EPA)	Fix your home
8 pCi/L	About 3 People could get lung cancer	< 10 times the risk of dying in an airplane crash	Fix your home
4 pCi/L	About 2 People could get lung cancer	< The risk of drowning	Consider fixing between 2 and 4 pCi/L
2 pCi/L	About 1 People could get lung cancer	< The risk of dying in a home fire	Consider fixing between 2 and 4 pCi/L
1.3 pCi/L	< 1 person could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/L is difficult
0.4 pCi/L	< 1 person could get lung cancer	(Average indoor radon level)	Reducing radon levels below 2 pCi/L is difficult

NOTE: If you are a former smoker, your risk may be higher.

[1] Home Buyer's and Seller's Guide to Radon, United States Environmental Protection Agency, Office of Air and Radiation (OAR), Office of Radiation and Indoor Air (ORIA) (6609J), Condensed from #402-K-00-008, July 2000

[2] Consumer's Guide to Radon Reduction, United States Environmental Protection Agency, Office of Air and Radiation, Office of Radiation and Indoor Air (6609J), 402-K-03-002, Revised February 2003