Dealing With Radon
In Real Estate Transactions

- **Answers to frequently-asked questions**
- **Practical Solutions for dealing with radon**
- **Facts about radon in Arizona**

ARIZONA RADIATION REGULATORY AGENCY

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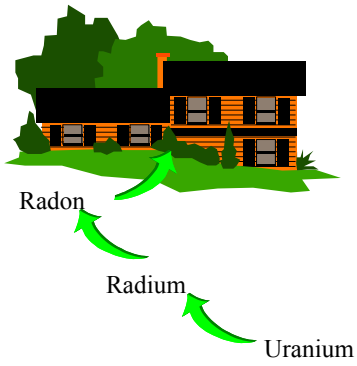
1 WHAT IS RADON?

Radon is an invisible, radioactive gas created from *natural* deposits of uranium and radium in the soil. Radon gas can be drawn into a building and accumulate to concentrations that can increase the potential for contracting lung cancer.

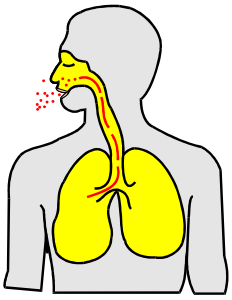
There are rare cases in other states where indoor radon has come from building materials that contained by-products of spent-uranium processing; but those instances are indeed *very* rare. Most of the radon in Arizona homes comes from the natural deposits of uranium commonly found in Arizona soils and rocks. Unlike some other environmental concerns, elevated indoor radon is seldom caused by human intervention.



Radon comes from natural deposits of uranium

2 WHY SHOULD I BE CONCERNED?

Radon is as natural as air and water, but cannot be detected by our senses. You can't see, smell, or taste radon.



Radon in soil is easily drawn into a home through the foundation. Radon is a radioactive gas that decays into a series of solid particles known as radon decay products. Formed from radon in the air, the particles become a fine aerosol that can be inhaled into your lungs. These solid decay products of radon are radioactive and can release alpha radiation while in your lungs, leading to an increased potential of lung cancer.

Carefully controlled studies in the U. S., Sweden and other countries have shown that the effects of radon decay products -- due to prolonged exposure to elevated levels of radon -- can significantly increase the chance of getting lung cancer.

Radon is regarded as a Group A carcinogen, known to cause cancer in humans with prolonged exposure to elevated levels. Many homebuyers are concerned about health risk as well as property resale value, and want to address radon concerns.

The Surgeon General of the United States and the U.S. Environmental Protection Agency (EPA) recommend that people avoid long-term exposures in excess of 4.0 picocuries per liter of air (pCi/L). EPA radon guidance refers to 4.0 pCi/L as the "recommended action level." If results of short-term radon tests show indoor levels exceed the 4.0 benchmark, EPA recommends follow-up action before deciding whether to mitigate.

3 HOW COMMON IS RADON IN ARIZONA?

Because small amounts of uranium exist in almost all soil and rock, radon's presence in Arizona soil does not surprise geologists. In fact, uranium mining was practiced in many parts of the state from the 1950s to the 1980s. Some Arizona residents mistakenly assume their home will not have a radon concern unless the home is located near the site

of a uranium mine. However, the amount of uranium in the soil needed to cause a concern for residential radon is far less than the amount needed to support uranium mining. The only way to know how much radon is in a home is to test.

3.1 Radon incidence in Arizona is similar to the national average

Results from the state indoor radon sampling survey conducted 1987-89 by the Arizona Radiation Regulatory Agency (ARRA) suggest that about 1 out of 15 Arizona homes may contain radon concentrations above the EPA recommended action level. That is comparable to the national average. However, Arizona's predominate warm, temperate climate can result in a lower thermal suction on the soil beneath a home than is typically found beneath homes situated in colder climates. Thus, even though radon is present, less may be drawn into a home here than in a comparable home in many other states.

3.2 Sub-floor ducts can allow radon entry.

Some Arizona homes have forced air conditioning systems that include a feature not often found in colder climates, such as return-air ducts located in the soil below slab floors. If these ducts are not airtight, radon-laden air from the surrounding soil can be drawn into the house through the ducts, resulting in higher indoor radon and increased mitigation cost. However, elevated radon in homes with sub-floor air ducts can be reduced effectively.

3.3 Evaporative coolers can help.

Indoor radon concentrations can also be reduced by the use of evaporative coolers, sometimes called "swamp" coolers, because they push cooled outdoor air into a building. This dilutes indoor radon levels and can offset the air pressure differences that typically bring radon into a home from the soil below.

Residential usage patterns can have an impact on average indoor radon levels:

Over time, the way residents actually use a home can strongly affect the level of indoor radon. For example, if the windows remain closed year-round, the home's average radon level will usually be higher than if occupants frequently ventilate the home when weather permits.

The only way to know the radon level in a home is to test.

3.4 Arizona Radon Facts

- Elevated levels of radon are found in both new and old buildings.
- Radon can be found in buildings other than homes.
- Radon can be found in homes built on all types of foundations, including slab-on-grade, basement, and crawlspace.
- The percentage of Arizona homes that contain radon above the EPA-recommended action level is similar to the U.S. average.

- The average radon level found in homes in the U.S. is about 1.4 pCi/L. The median of radon levels found in 4000+ homes during the Arizona state indoor radon survey (1987-89) was about 1.6 pCi/L.

- Radon can vary from house to house. The only way to know how much radon may be in the house you are buying is to have it tested.

- Sub-floor ductwork for forced air furnaces and air-conditioners can draw radon-laden soil gas into a home.

- Radon levels in Arizona can often be higher in the summer air conditioning months than during months with milder temperatures.

4 HOW DO I TEST FOR RADON?

Over the last 15 years, reliable testing devices and methods have been developed to determine indoor radon exposures. When using approved measurement devices, you can either determine the radon *potential* of the home under "worst case conditions" (short-term test), or what your *actual average* exposure will likely be after you move in (long-term test).

4.1 The Test Purpose Will Dictate Test Conditions

Radon Potential	***Occupant Exposure***
▪ Short term test	▪ Long term test
▪ Typically 2-5 days	▪ Typically 91 days - one year
▪ Closed building conditions 12 hours prior to and all during test	▪ Normal lived-in conditions
▪ Device deployed on lowest ***occupiable*** level of home	▪ Device deployed on lowest ***occupied*** level of home
▪ Commonly used at time of resale	▪ Commonly used outside of a real estate transaction, or used as basis of escrow fund release

4.2 Key Points About Testing

Homebuyers and sellers often prefer to have a radon test performed by a trained professional tester. EPA strongly recommends the use of a qualified radon measurement professional trained in the proper placement of radon measurement devices and the interpretation of their results.

The state of Arizona does not certify radon testers or mitigation contractors. To find qualified radon contractors, see Paragraph 13 on page 11 of this booklet.

Points to remember for conducting a radon test:

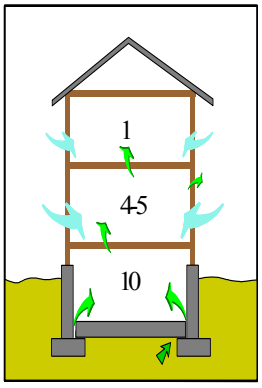
- Radon test devices are to be placed in livable areas - not in attics or crawlspaces.
- Radon detectors are to be placed no closer than 20 inches to the floor, and no closer than three feet from openings in exterior walls, such as windows and doors.
- Collecting data for less than 48 hours is not valid for determining the need to reduce radon in a home.

- When performing a short-term test of less than 90 days, all exterior doors and windows are to be closed, other than for normal entry and exit, and the test device is to be placed in the lowest level of the home suitable for occupancy.
- When performing a long-term test of more than 90 days, no special conditions are required, and the device typically is placed in the lowest level of a home that is frequently occupied.
- Radon levels vary from season to season and long-term tests are the preferred method for determining health risk.
- For most homes, radon detectors need to be placed in only one room on the selected level of the home.
- If the radon measurement professional performs two short-term tests at the same location, under the same conditions, but at different times, the results should be averaged. It is not acceptable to continue to test until a preferred result is obtained.
- Radon test results obtained from different parts of the home are NOT averaged.
- During short-term tests, evaporative coolers (swamp coolers) and other devices that cause a significant exchange of outdoor air for indoor air should be shut-off unless part of a bonafide radon mitigation system.
- Test devices should not be placed on hot surfaces, or in areas of elevated humidity.
- If a continuous monitor (which measures radon hourly) is utilized, the average of the measurements is used to determine the need for follow-up, rather than the highest reading observed.
- Continuous monitors are sometimes used to detect occupant tampering of test conditions.

5 SHORT-TERM TESTS: HOW TO DETERMINE RADON POTENTIAL

Often, at the time of resale, it is desirable to know what the potential radon exposures could be, independent of how a person operates or lives in a building. Short-term tests are typically conducted over a period of two or three days. Results of short-term tests represent the radon potential of the home instead of the average exposure under normal conditions, unless the residents keep the home's windows and doors closed year-round.

That's because the short-term test requires "closed-house conditions" when conducted under EPA recommended guidelines. The placement of the device within the home must follow manufacturer's instructions and is dependent on whether or not the test is being conducted for a real estate transaction.



Radon concentrations are typically highest in the lowest occupiable portion of a home

5.1 What does a short-term test tell me?

If a short-term radon test is conducted in the lowest livable portion of a home while all exterior doors and windows are closed for a minimum of two days, one can reasonably say:

- Radon concentrations are less on upper floors.
- If the result is less than 4.0 pCi/L, the annual average of the home, under normal lived-in conditions, is also likely to be less than 4.0 pCi/L.
- If the level is at or above 4.0 pCi/L, the house has the potential for being above 4.0 pCi/L and you should consider follow-up testing or taking action to reduce (mitigate) the radon in the home.

6 LONG-TERM TESTS: HOW TO DETERMINE RADON EXPOSURE

For the occupants of a home, actual radon exposure depends upon how they use the home, where the occupants spend their time in the home, and how much fresh air is brought into the living areas. Since these factors may vary over time, the only reliable way of measuring the actual radon exposure is to conduct a long-term test for a minimum of 91 days under normal living conditions.

In the past, prospective homeowners have sometimes been reluctant to purchase a home before performing a long-term test, for fear of not being able to correct a radon problem afterward. However, improved technology and the proven durability of radon mitigation systems have served to reduce much of that concern.

This does not mean that a short-term test is less valuable as part of a home inspection process; but rather, if the results of that test show a potential for radon concern, a long-term test can more accurately show average radon levels. By conducting a long-term test after moving into a home, the homeowner can control test conditions and, if needed, make decisions on how the mitigation system will be installed to accomplish the best reduction and to increase the value of the home.

7 RADON DECAY PRODUCT MEASUREMENTS

Radon decay products (actual health risk of radon) also can be measured using a special monitor that reports in Working Levels (WL). This can be done as an initial measurement or, more typically, after initial measurements have identified a potential concern in commercial buildings or homes with relatively low initial radon readings. The EPA guidance for radon decay products (comparable to 4.0 pCi/L of radon) is that people should avoid long-term exposures in excess of 0.02 WL of radon decay products.

8 HOW SHOULD I APPROACH RADON TESTING IN MY SEARCH FOR A NEW HOME?

Radon testing is simple. Here is a common approach:

1. As part of the home inspection process, request a short-term radon test, using a qualified radon measurement professional. Your home inspector may be qualified to conduct radon testing.
2. If the short-term test result is less than 4.0 pCi/L, the EPA does not recommend any follow-up action, although there still is some risk at exposures less than 4.0 pCi/L.
3. If the short-term test result is 4.0 pCi/L or higher, then consider asking the seller to fix it, or consider purchasing the home and performing a long-term test to determine the actual average exposure.
4. If mitigation is needed, seek bids from qualified contractors who are willing to guarantee results and provide a warranty.

5. Request that contractors' bids specify whether the radon will be mitigated before or after the buyer takes possession of the property. Bids can be used as a basis for negotiations or even to establish escrow funds that can be used to mitigate the house later if elevated levels are confirmed.

Test the home. If the radon is higher than recommended, take comfort In knowing it can be fixed -- even after you take possession.

9 IF I FIND A HOME WITH A RADON PROBLEM, SHOULD I LOOK FOR ANOTHER HOME?

Only you can decide. The information in this booklet should allow you to make an informed, timely decision, knowing that radon doesn't have to be a serious problem. If you like the house, but a valid short-term test indicates elevated radon, consider taking a reasoned approach that will confirm radon levels and evaluate mitigation contingencies.

Radon can be a problem, but it's a problem you can fix.

10 COULD THERE BE RADON IN MY WATER?

Yes, radon can dissolve in the groundwater and be released into the air of the home when it is used for showers, laundry, and other purposes. Most dissolved radon is quickly released when water meets air.

The concern with radon in water is not widespread and is primarily associated with water that comes directly into homes or other buildings from groundwater wells. Municipal water supplies, aerated during purification, pose little or no health concern from radon.

The major concern is not with drinking the water, but rather the additional amount of radon added to the breathing space in a home, school or workplace. Normal radon-in-air tests measure this contribution if the house is occupied and water is used routinely during testing. It takes a lot of radon in the water to have a measurable effect on the indoor radon level of a home. As a rule of thumb, it takes 10,000 pCi/L in the water to add one pCi/L to the air.

EPA recommends testing the air first, before becoming concerned about radon in the water. If radon in the air is below the recommended action level, then radon in water is not a cause for concern. A radon testing professional should be able to provide additional guidance, if needed.

11 HOW DO I TREAT RADON?

Research by public and private agencies, combined with years of extensive hands-on mitigation experience and long-term follow-up studies, have formed a strong knowledge base of proven mitigation techniques for homes, schools, and commercial buildings. The techniques are straightforward and, for a typical single-family residence, can be done in one day by a qualified contractor.

Radon reduction does require more than just trying to seal openings in the foundation. *In fact, caulking and sealing of foundation openings, on its own, has proven not to be a reliable or durable technique. However, sealing is done in conjunction with other mitigation steps.*

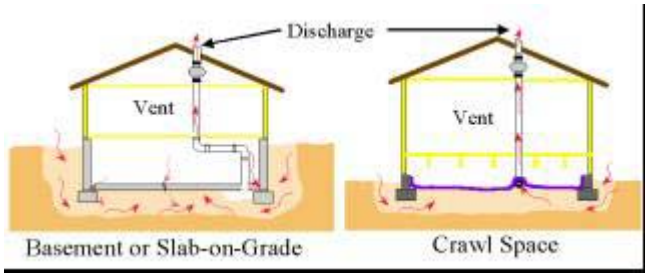
For most homes, radon mitigation is accomplished by installing a system that will draw the radon-laden soil gas from beneath the foundation and exhaust it outside the building. The radon must be exhausted far enough away from windows and other openings that it will not reenter.

A radon reduction system typically consists of a plastic vent pipe connected to the soil, either through a hole in a slab, via a sump lid connection, or beneath a plastic sheet in a crawl space.

Attached to the pipe is a quiet, continuously operating fan that discharges the radon outdoors.

The system design and the number of vent pipes are determined by the construction and size of the home, rather than the radon concentrations that exist. A home with more than one foundation can present challenges to collecting the soil gas from under all portions of the building. However, talented mitigation contractors can sometimes connect multiple systems together so that only one fan system is required.

Crawlspace foundations can be more costly, since the contractor needs to install a high-density plastic sheet over the soil and seal it to the walls then route the piping to the fan. In addition to reducing radon, this type of system also helps reduce any moisture in the crawlspace.



- *Average U.S. installation cost: $1,200*
- *Average operating cost in Arizona: $3.00/month*
- *Expected life span of fan: 11 years*
- *Fan replacement cost: $145-300*
- *Periodic maintenance: none*

In some Arizona homes, return-air ductwork for the forced air conditioning system is located beneath a slab floor. If the buried ducts are not sealed against the soil, radon pulled into the house by the air conditioner fan can offset the ability of a mitigation system to draw radon from below the floor. However, even with this type of construction, there are effective ways to reduce radon.

In some cases, a contractor may propose that the ductwork be removed and re-routed within the interior of the home. This can certainly help, but it can also be expensive. You may wish to have an additional short-term test performed that would specifically measure the level of radon decay products, since they are particles that can be beneficially reduced by the operation of an air handler with HEPA filters. The EPA recommended action level for radon decay products is 0.02 Working Levels (0.02 WL).

11.1 SOME KEYS TO EFFECTIVE RADON MITIGATION

The first consideration is to use a qualified contractor who will install the system in accordance with the EPA recommended mitigation standards and applicable local building codes. The EPA's model standards provide helpful, specific guidance. For example:

- The discharge point of the system can contain elevated levels of radon. To avoid exposure to occupants and neighbors it must be:

- At least 10 feet above grade;
- At least 10 feet away from any opening that is less than two feet below the discharge; and
- Above or at the eave of the roof.
- The piping may be routed outside the home, with the discharge meeting the preceding three criteria.

- System fans should not be located inside the home or in a crawlspace. They can be in an attic, outdoors, or in a garage, provided there is no living space above the garage.
- An indicator that allows the home's occupant to verify the system is functioning properly should be installed in a prominent place.
- Power to the fan should be supplied in accordance with local electric codes; including permits where required.
- All portions of the system are to be labeled and a simple instruction manual, with warranties, provided to the homeowner.
- All homes with mitigation systems should be tested no sooner than 24 hours (nor later than 30 days) after installation to verify reduction. The home should also be retested every two years to verify radon levels.

11.2 WHAT FACTORS IMPACT THE COST OF MITIGATION?

The cost of a home's mitigation system may vary according to the home's design, size, foundation, construction materials, and the local climate. A large part of the mitigation expense may be the cost of concealing the system to maintain the aesthetic value of the home. For example, a retrofit system routed outside the house can reduce radon quite well, but it may not be as visually pleasing as one routed through an interior closet.

12 DO NEW HOMES HAVE RADON SYSTEMS?

Although most new homes in Arizona do not have radon mitigation systems, a number of Arizona homebuilders do add construction elements to new homes that help make the homes radon-resistant. Some go so far as to install a complete system even though no building codes in Arizona currently mention radon-resistant construction features. In other states, some homebuilders include radon-resistant construction elements as a value-added feature, or when requested by homebuyers.

In addition to cost benefits, there are other advantages to installing a system when building a house. For example:

- The piping can be easily concealed in a chase;
- The vent pipe can exit the roof and appear as a normal roof penetration;
- The sub-grade can be prepared to make it easy to collect radon; and
- In many cases, these systems work passively without the need for fans.

Ask your builder is radon-resistant features are a part of the home.

If a radon reduction system is installed, test the home to be sure the system reduces radon to levels with which you are comfortable.

During the construction of a home, it is relatively easy to treat several foundations by connecting each area to a single vent, that may be concealed in walls. Plus, the system may be effective without the need to install and operate a fan.

A Contractor can route the vent pipe in a way that allows easy installation of a fan later, after radon levels are tested in the completed home. Then, if needed, a fan can be installed within the attic area, to make the system more effective.

There may be areas of Arizona where regulations govern installation of vent pipes in general, rather than referring specifically to radon-reduction systems. Check with your builder and local building department.

National codes dealing with radon are under consideration. EPA has published model standards and techniques for control of radon in new residential buildings, and the International Code Council has published similar guidance.

13 HOW DO I FIND QUALIFIED RADON MEASUREMENT AND MITIGATION CONTRACTORS?

The Arizona Radiation Regulatory Agency (ARRA) does not regulate or certify radon testers or mitigation specialists.

Contractors are licensed and regulated in Arizona by the Arizona Registrar of Contractors (ROC). Radon testers or mitigation specialists may need to be licensed by the ROC. You can contact the ROC by telephone, at(602) 542-1525 if calling from within Maricopa County, or toll-free at (888) 271-9286. Information is also available at the ROC web site: www.rc.state.az.us.

In real estate matters, EPA recommends using a qualified professional contractor who knows and uses EPA protocols to test or mitigate homes. To find qualified radon contractors, EPA recommends that you contact one or both of the two privately run national certification programs listed below.

National Environmental Health Association National Radon Proficiency Program (NEHA NRPP)		***National Radon Safety Board (NRSB)***	
Address:	PO Box 2109 Fletcher, NC 28732	Address:	PO Box 703 Athens, TX 75751
Phone:	(800) 269-4174; (828) 890-4117	Phone:	(866) 329-3474
Fax:	(828) 890-4161	Fax:	(903) 675-3748
Email:	angel@neha-nrpp.org	Email:	info@nrsb.org
Website:	www.neha-nrpp.org	Website:	www.nrsb.org

In addition to asking about a radon contractor's training and credentials, homeowners should always:

1. Ask for references;
2. Require proof of certification, including agreement to follow protocols and codes of ethics;
3. Ask for proof of insurance including workers' compensation; and
4. Ask for a clear contract with details of guarantee and warranty.

14 RESOURCES

Individual copies of this booklet and a selection of other radon-related publications can be obtained by calling the office of the Arizona State Indoor Radon Grant Program administered by the Arizona Radiation Regulatory Agency, at (602) 255-4845, extension 244, or by sending an email message to radon@arra.state.az.us.

Many publications and resources on the subject of radon, as well as other environmental concerns addressed by the U.S. Environmental Protection Agency, can be found at www.epa.gov. Detailed information on indoor air quality issues is available at www.epa.gov/iaq, and EPA radon information, including all EPA publications on the subject is available at www.epa.gov/iaq/radon.

Inexpensive and easy-to-use home indoor radon test kits are available from hardware stores, building supply stores, and department stores, or by calling the National Safety Council/EPA radon information line at 1-800-767-7236, or the Arizona Consumers Council at (602) 265-9625.

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