Radon Sources

Healthy Indoor Air for America's Homes
Radon in the Home Instructional Module
Slide #1
What is Radon?

- Odorless, tasteless gas from natural radioactive decay of uranium and radium.
- Radon decay products carry small static charges that allow attachment to water vapor, dust and smoke.
- Radon is measured in Pico Curies per liter (pCi/L) of air.
- Annual levels above 4 pCi/L are considered excessive.
Sources of Radon

- Rock: granite, shale phosphate, pitchblende
- Dry, permeable soils
- Well water
- Natural gas
- Some building materials (concrete)
EPA Map of Radon Zones
Help is Available

• Local help is often available for mitigating radon
• State Department of Health or State Radon Contact (*EPA’s Building a New Home: Have You Considered Radon?*)
• IAQ Info Clearinghouse – 1-800-438-4318
Drinking Water

EPA has a national hotline for drinking water concerns. If you suspect your water is a source of radon, call 1-800-426-4791.
How Does Radon Enter Your Home?

1. There must be uranium in the soil
2. Soil must be permeable, which allows radon to move into your basement or crawlspace
3. Pathways for radon to enter indoors must be present (holes, cracks, plumbing, sumps)
4. Air pressure indoors must be lower than in the surrounding soil

All four conditions must be present to have a radon problem!
Man-Made 18%

Natural 82%

% Contribution of Radon to the Total Average Effective Dose Equivalent in the U.S. Population (NCRP - 1987)

Radon 54%

Cosmic 8%

Terrestrial 8%

Internal 11%

Medical X-Rays 11%

Nuclear Medicine 4%

Consumer Products 3%

Other <1%

Occupational 0.3%

Fallout <0.3%

Nuclear Fuel Cycle 0.1%

Miscellaneous 0.1%
### Radon Risk If You Smoke

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

Note: If you are a former smoker, your risk may be lower
# Radon Risk If You’ve Never Smoked

<table>
<thead>
<tr>
<th>Radon Level pCi/L</th>
<th>If 1,000 people who never smoked were exposed to this level over a lifetime...</th>
<th>The risk of cancer from radon exposure compares to...</th>
<th>WHAT TO DO:</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>About 8 people could get lung cancer</td>
<td>➡️The risk of being killed in a violent crime</td>
<td>Fix your home</td>
</tr>
<tr>
<td>10</td>
<td>About 4 people could get lung cancer</td>
<td></td>
<td>Fix your home</td>
</tr>
<tr>
<td>8</td>
<td>About 3 people could get lung cancer</td>
<td>➡️10 times the risk of dying in an airplane crash</td>
<td>Fix your home</td>
</tr>
<tr>
<td>4</td>
<td>About 2 people could get lung cancer</td>
<td>➡️The risk of drowning</td>
<td>Consider fixing between 2 and 4 pCi/L</td>
</tr>
<tr>
<td>2</td>
<td>About 1 person could get lung cancer</td>
<td>➡️The risk of dying in a home fire</td>
<td>Fix your home</td>
</tr>
<tr>
<td>1.3</td>
<td>Less than 1 person could get lung cancer</td>
<td>➡️(Average indoor radon level)</td>
<td>(Reducing radon levels below 2 is difficult)</td>
</tr>
<tr>
<td>0.4</td>
<td>Less than 1 person could get lung cancer</td>
<td>➡️(Average outdoor radon level)</td>
<td></td>
</tr>
</tbody>
</table>
Seasonal Influences on Radon Concentrations

- Radon induction maximum during winter months
- With frozen ground, radon follows path from the soil below the frost line to the foundation
- Heating systems create negative pressure which helps induct radon
Home Construction

Foundation Construction Type

- All Conventional house construction types have been found to have radon levels exceeding 4 pCi/L

Construction Quality

- Both energy efficient and poorly-weatherized homes have been found to have radon levels exceeding 4 pCi/L
Do-It-Yourself Monitoring

*Short-Term Testing*

Activated Carbon Detector

- Short-term initial testing (2-7 days). Requires careful control of closed-house conditions.
- About $15 per test kit
- Tests done twice for real estate transactions, with average result used for reporting
More Monitoring and Testing

Long-Term Testing

Alpha Track Detector

- Takes \textit{at least} a month to measure a reliable average radon concentration
- Should be left in place for 90 days (or even up to one year)
- About $25 per test kit (includes postage and test results)

Professional Monitoring

- Select “EPA Listed Contractor”
- Check your yellow pages
- Call your State Department of Health for list
**Radon Detector Placement**

- Follow test kit instructions
- Place detector at least 20 inches above floor in a location where it won’t be disturbed
- Keep windows and doors closed as much as possible (best to test in winter)*
- Place detector in lowest, lived-in level of the home
- Don’t place detector near floor drains, floor/wall crack, sump
- Place detector out of draft – avoid ceiling fans, air registers, exhaust vents
- Keep detectors away from high heat and moisture (bathroom, kitchen, laundry, utility)

*Pertains to short-term testing only*
Mitigation Strategies in Existing Homes

- Seal radon entry points
- Reduce pressure-driving forces

Homes with Basements
- Install active soil depressurization system

Homes with Crawlspace
- Ventilate crawlspace
- Install sub membrane depressurization
Sealing Cracks and Openings

- Seal walls with waterproofing painting, cement, or epoxy
- Water traps in floor drains
- Seal cracks with flexible polyurethane membrane sealants
Reduce Pressure-Driven Air Flow

- Seal penetrations in ceiling
- Weatherstrip attic hatch
- Avoid using recessed lights
- Provide outside air supply to combustion appliances
- Ventilate with balanced air-to-air heat exchanger
- Provide air-supply ports for exhaust-only ventilation
- Ventilate crawlspace
Negative Pressure Sources in a Typical Home
Sub-Slab Suction
Crawlspace Foundation
Basic Radon Control Ventilation

- Provide tempered make up air for large capacity exhaust devices (I.e. Jennerl)
- Seal house air barrier to reduce stack effect. (SGC advanced air leakage control best)
- All ductwork joints and seams in crawlspace to be taped. All floor grill penetrations to be sealed to subfloor
- Provide combustion air to the box of all fireplaces and woodstoves
- Glue all joints in subflooring
- Seal all penetrations in subflooring
- Provide screened vent openings to meet local code requirements
- Provide drain tile as required by local code
- Provide freeze protection for pipes in crawlspace all water
- Place 8 mil or cross laminated polyethylene over entire crawlspace floor. Lap all joints 12".
Radon and Real Estate

- States have various requirements for disclosure of radon awareness in real estate transactions
- Contact your State Radon Office or the Real Estate Board for up-to-date information
- More information in EPA’s Home Buyer’s and Seller’s Guide to Radon
- *Radon can be a major concern in any real estate transaction*
BEIR VI Report

- Results of the Biological Effects of Ionizing Radiation (BEIR) VI Report – “The Health Effects of Exposure to Indoor Radon”
- February 1998
- Executive Summary available at EPA website: [http://www.epa.gov/iaq/radon](http://www.epa.gov/iaq/radon)
Key Points From BEIR VI

• Confirms radon is 2nd leading cause of lung cancer in U.S.
• Radon causes 15,000 – 22,000 lung cancer deaths each year
• Affirms EPA’s radon policies are grounded in strong science
• NAS found even small exposures of radon can result in lung cancer
• Smokers will get lung cancer due to radon exposure
Further Information

- EPA’s website... [http://www.epa.gov/iaq](http://www.epa.gov/iaq)
- NAS home page... [http://www.nas.edu](http://www.nas.edu)
- Local Extension *Healthy Indoor Air for America’s Homes* State Coordinator
- National Academy Press searchable version of BEIR VI... [http://books.nap.edu/books/0309056454/html](http://books.nap.edu/books/0309056454/html)