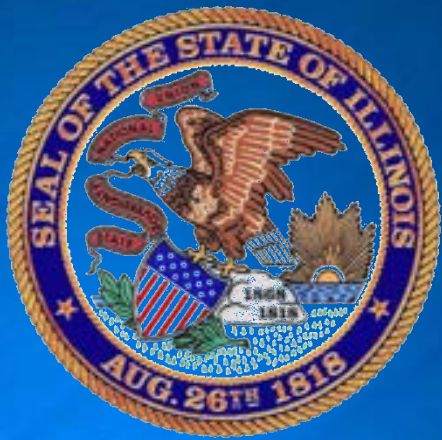


# Radon Basics for Building Officials

**PATRICK DANIELS**

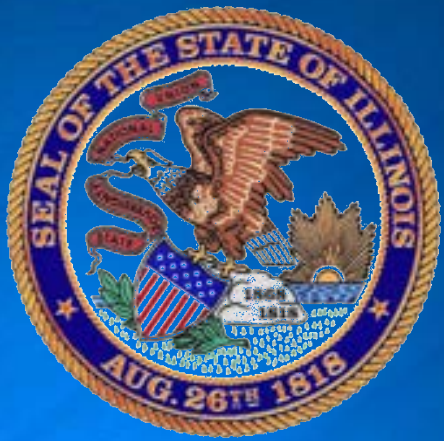
**IEMA RADON PROGRAM**



# What is Radon?

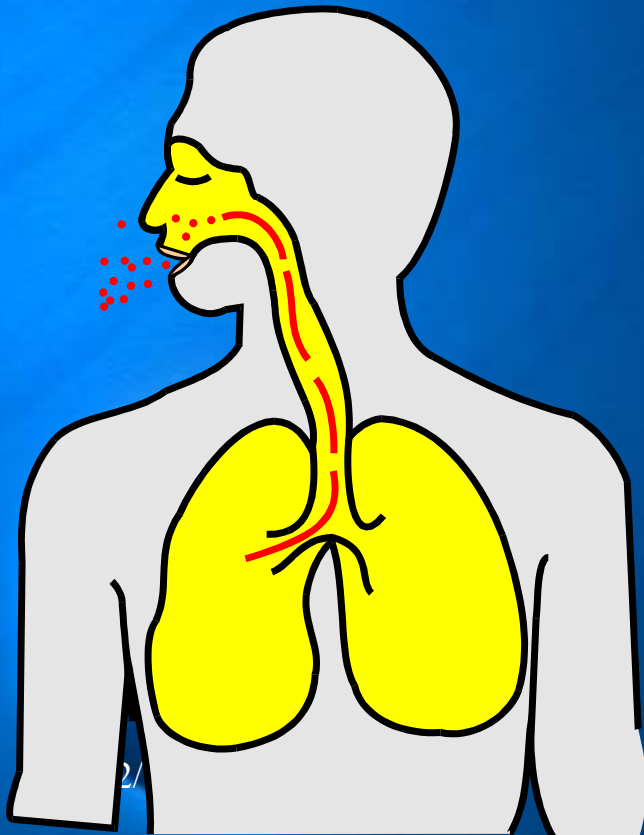
- Radon is an indoor air pollutant.
- Radon is a colorless, odorless radioactive gas that comes from naturally occurring uranium in the soil.
- The only way to tell how much radon a home has is to **TEST**.





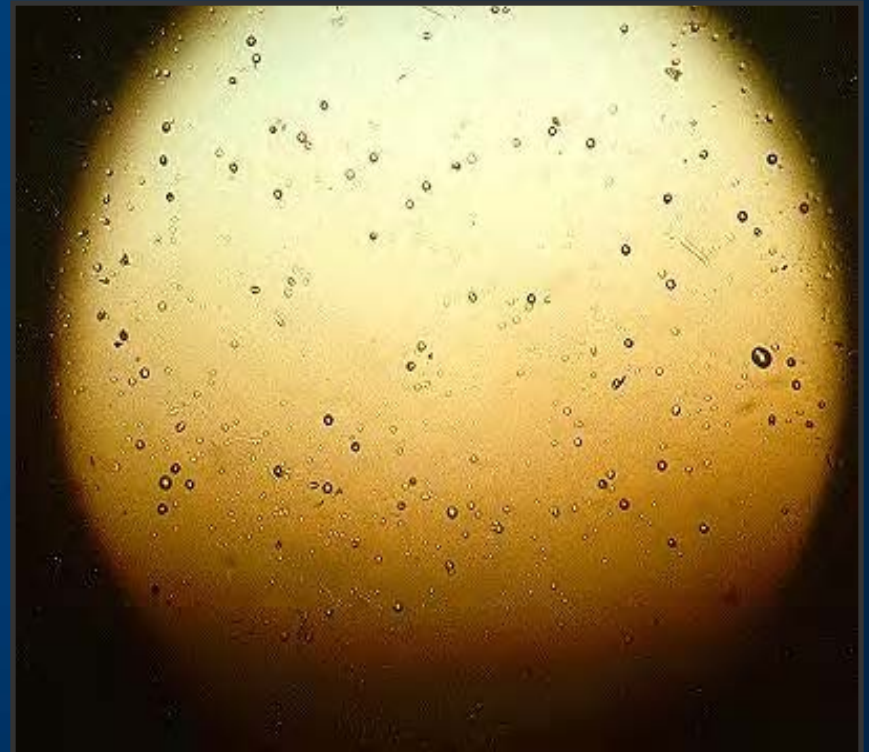
# Radon Exposure

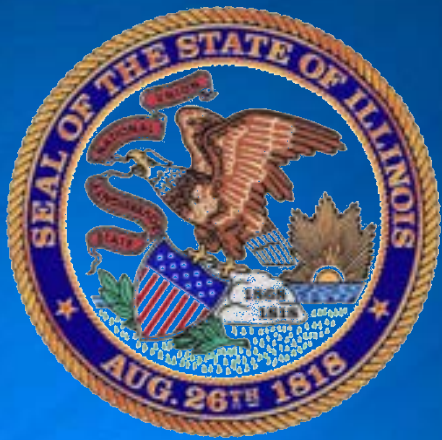
- Radon and Radon Decay Products (RDPs) are breathed in and the Radon is exhaled.
- RDPs remain in lung tissue and are trapped in the bronchial epithelium and emit alpha particles which strike individual lung cells and may cause physical and/or chemical damage to DNA.



# Alpha Particle Damage

**Alpha Particles are strong enough to pit plastic.**



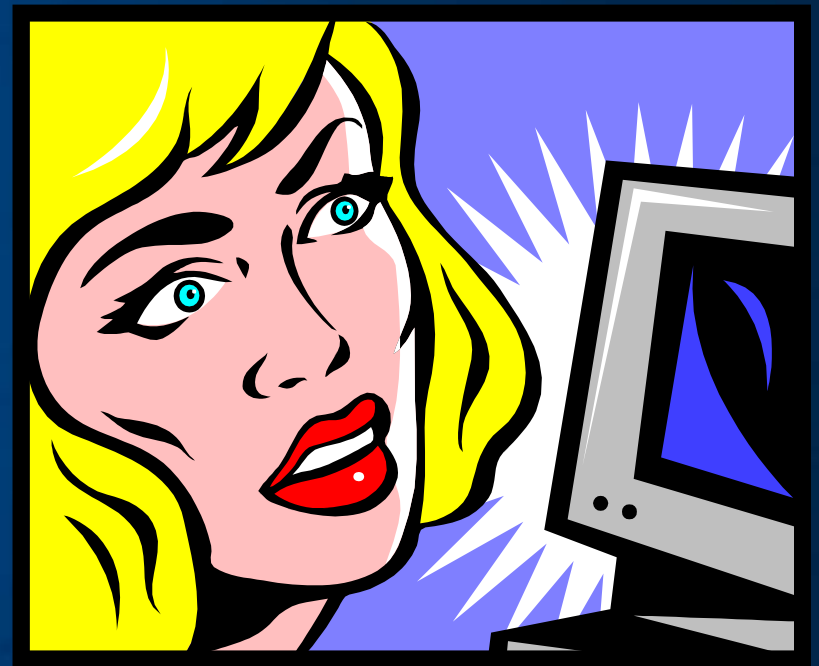


## Radon Risk Estimates

- USEPA's 2003 Assessment of Risks from Radon in Homes estimates radon causes about 21,000 lung cancer deaths per year.
- The Illinois Emergency Management Agency and the USEPA estimate that as many as 1,160 Illinois citizens are at risk of developing radon related lung cancer each year.

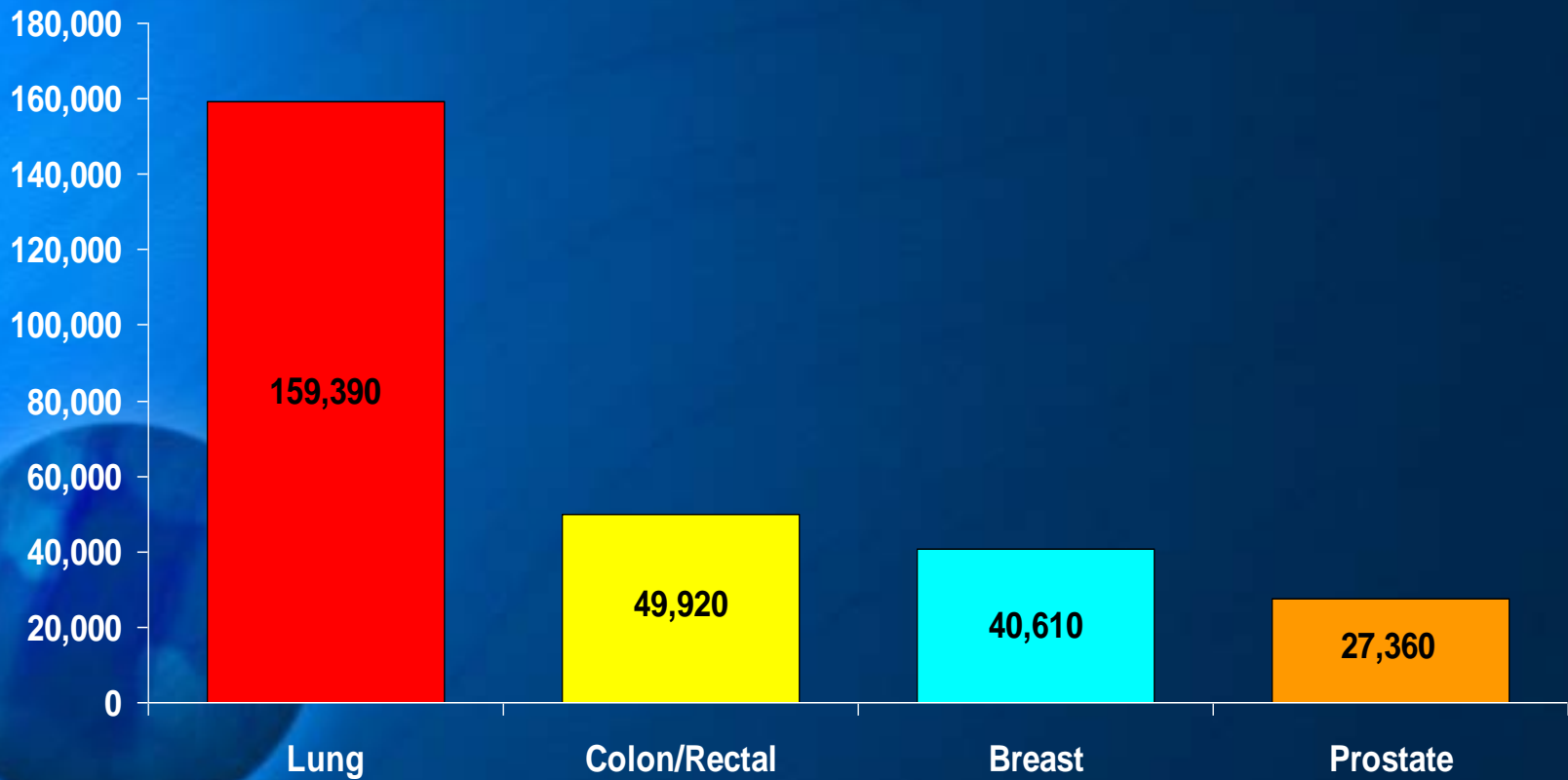
# Did you know?

- More Americans die each year from lung cancer than from breast, prostate, and colorectal cancers combined.

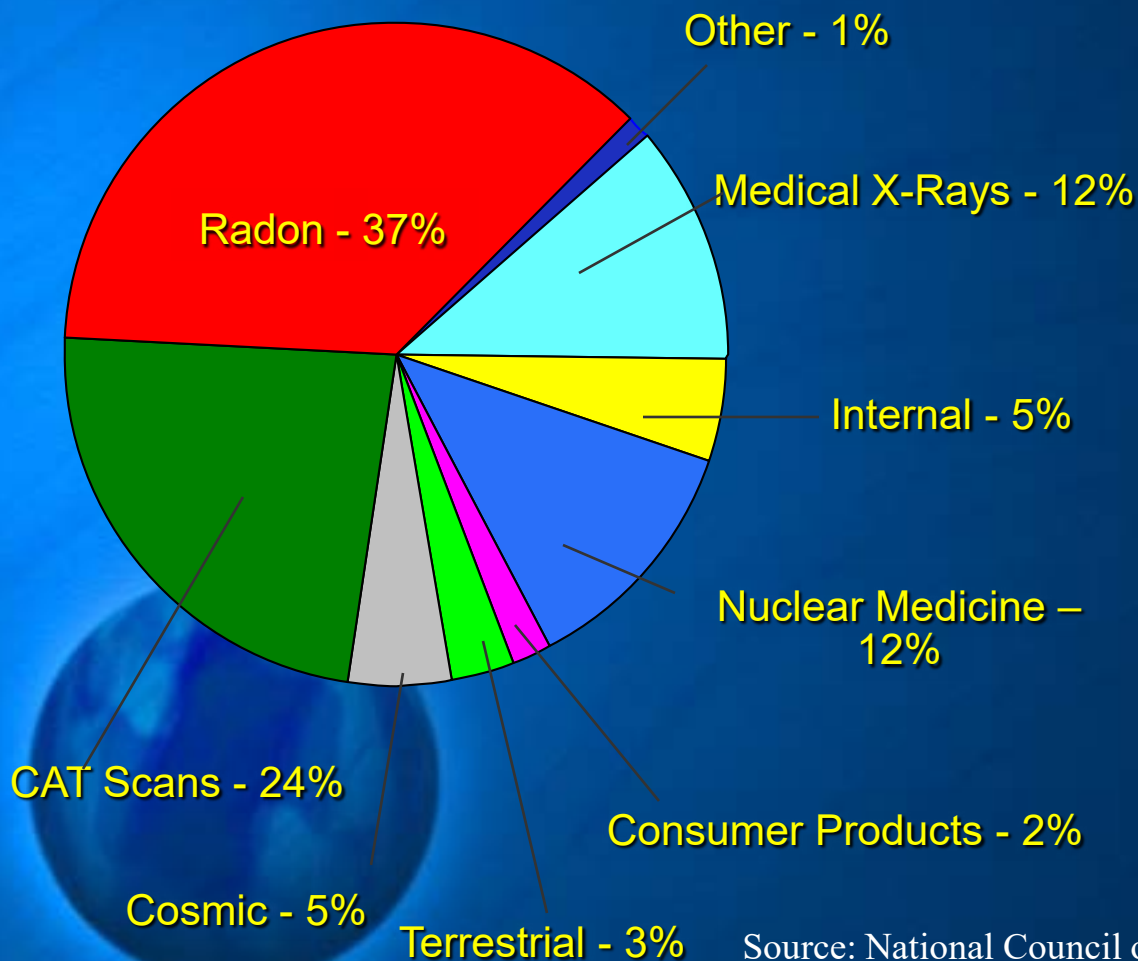


# Lung Cancer Mortality Rates

**Estimated Mortality of Lung Cancer in 2009**  
"2009 Facts & Figures" - American Cancer Society



# Sources of Radiation Exposure to US Public 2009

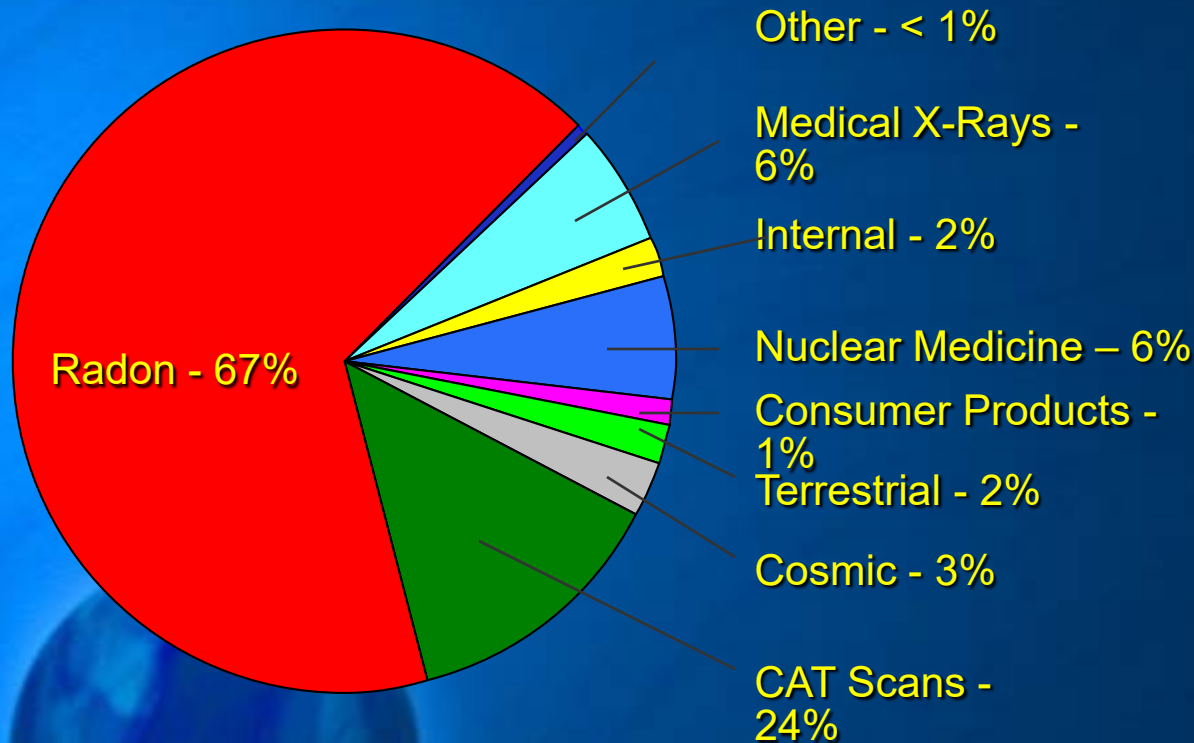


- Average Exposure 620 mrem
- Assumes average indoor radon concentration of 1.3 pCi/L.
- Radon is by far the greatest single source of radiation exposure to the general public.

Source: National Council on Radiation Protection (NCRP Report 160)



# Sources of Radiation Exposure in Illinois



- Average Exposure 1,170 mrem
- Assumes average Illinois indoor radon concentration of 4.4 pCi/L.
- Radon is by far the greatest single source of radiation exposure to the general public in Illinois.

# Radon Risk in Perspective

- Comparative Risk Assessments by EPA and its Science Advisory Board have consistently ranked Radon among the top four Environmental risks to the Public.
- In 1998 Harvard Risk in Perspective, by John Graham, ranked Radon the #1 risk in the Home

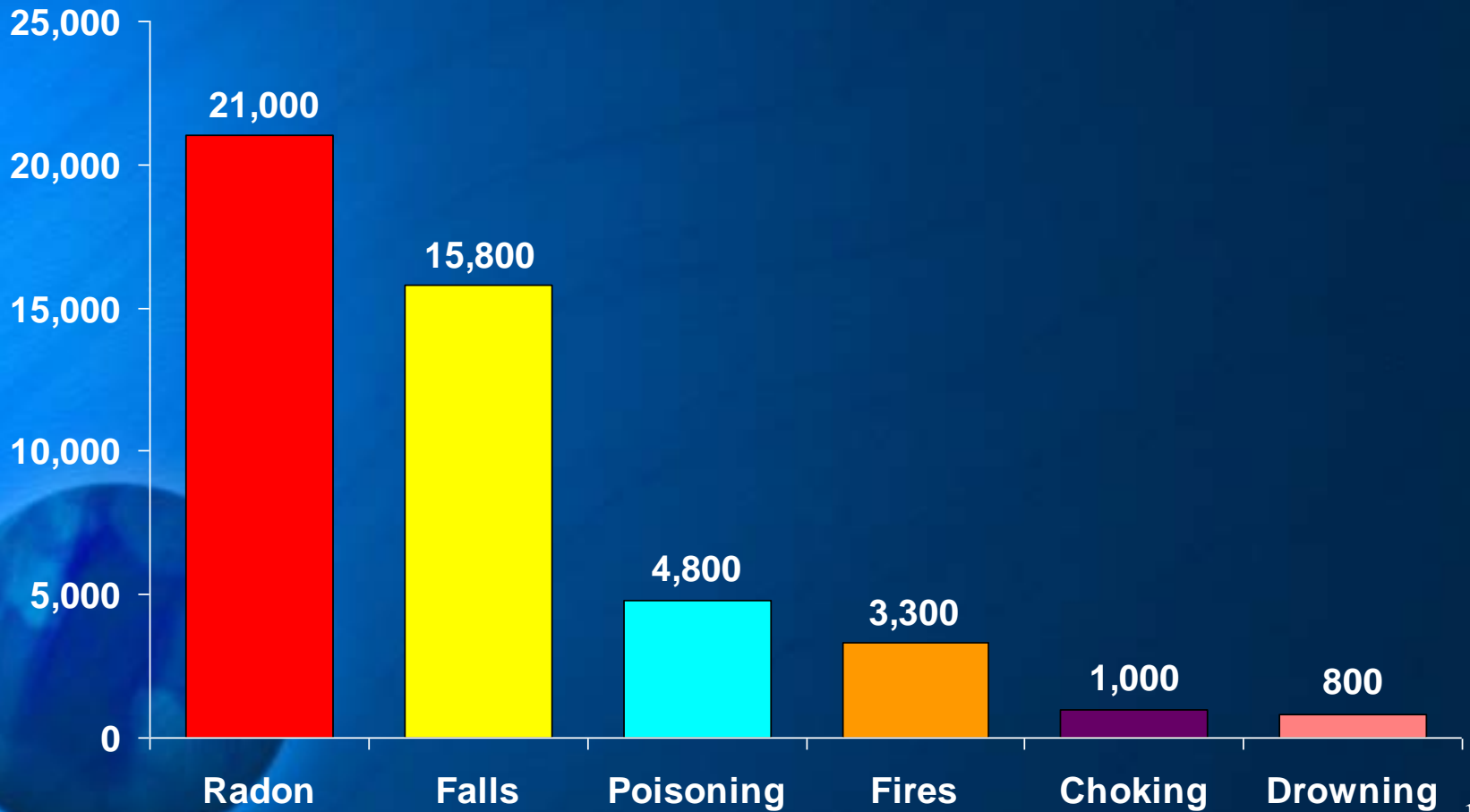


# Did You Know?

- Top five causes of accidental home injury deaths:
  - Falls
  - Poisoning
  - Fires
  - Choking
  - Drowning
- Deaths due to radon induced lung cancer is greater than all of these.

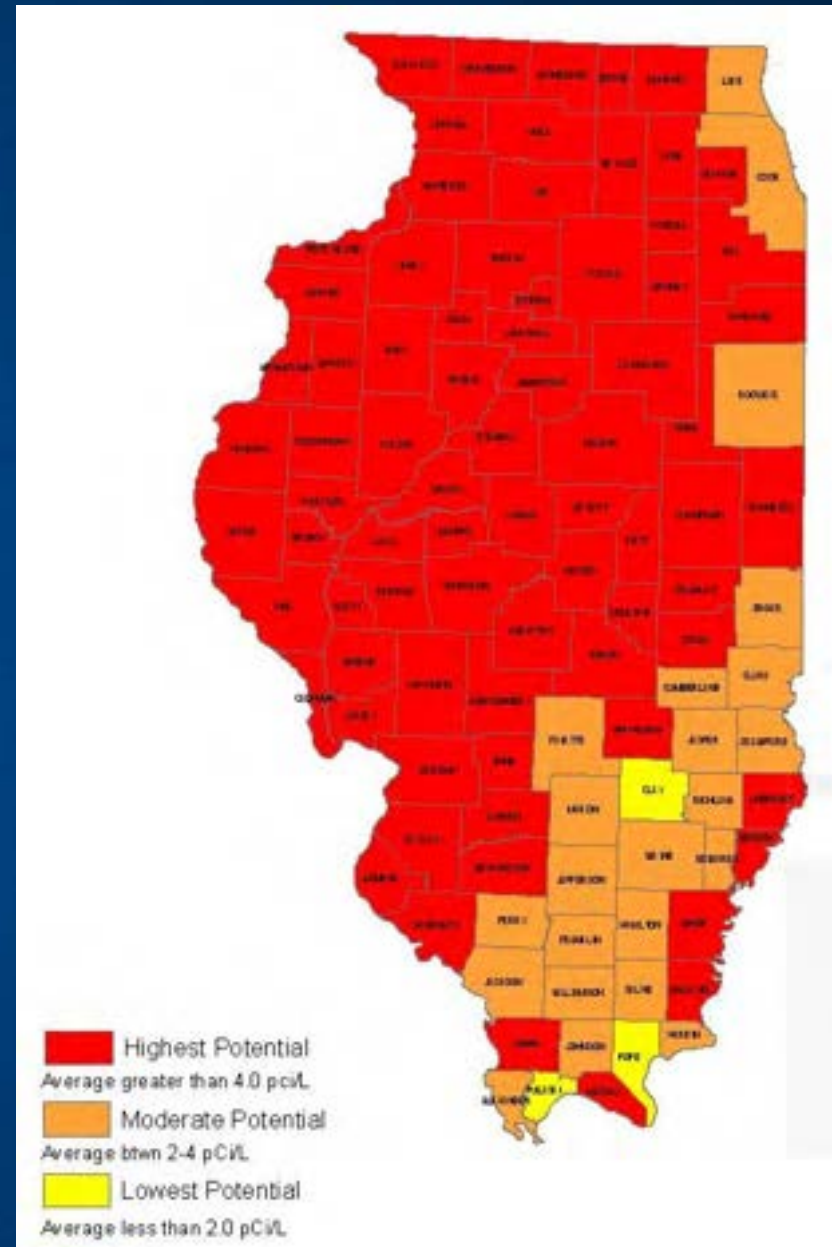


# Home Safety Council Risks





- Average Indoor Radon Concentration by County
- The only way to tell how much radon a home has is to **TEST**.



# Statewide Results from IEMA Professional Licensee Measurements

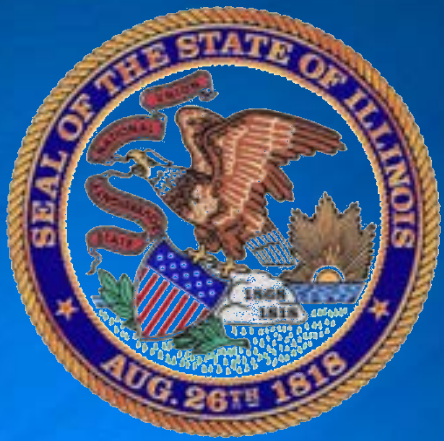
118,447 Homes Tested

48,978 of the homes tested were  $> 4.0$  pCi/L

41% of the homes tests were  $> 4.0$  pCi/L

Average Radon Concentration 4.9 pCi/L

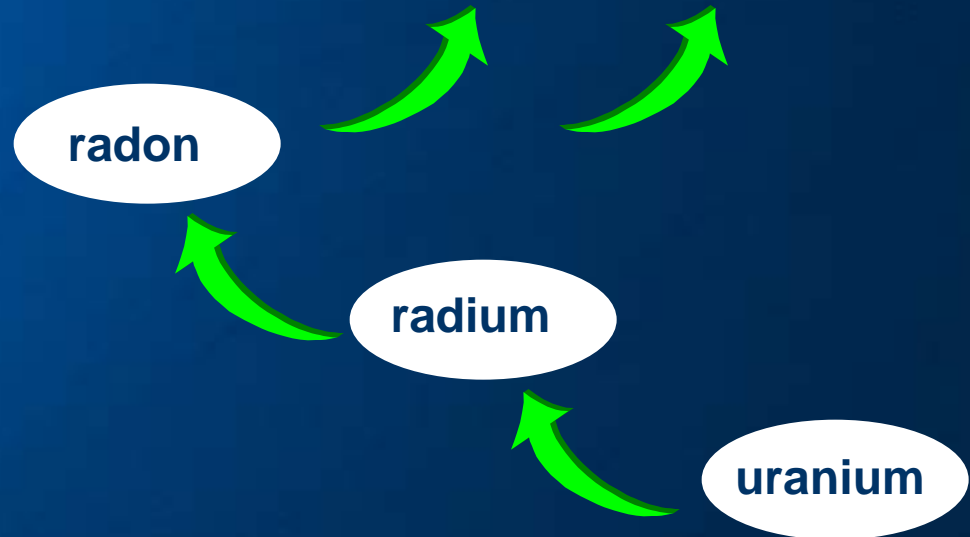


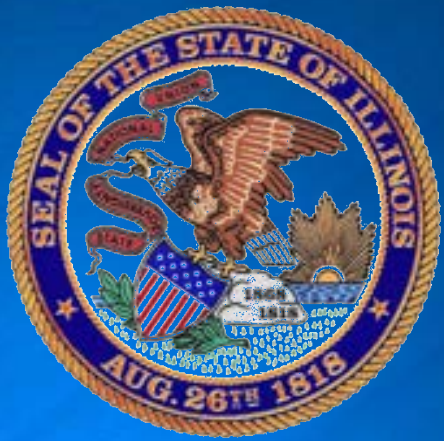


# Radon Entry

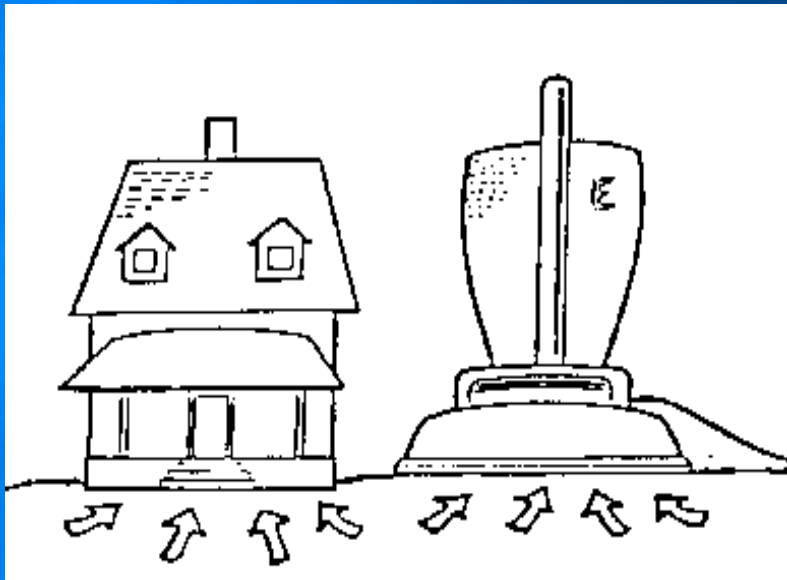


- Radon enters through any opening between the building and the soil.



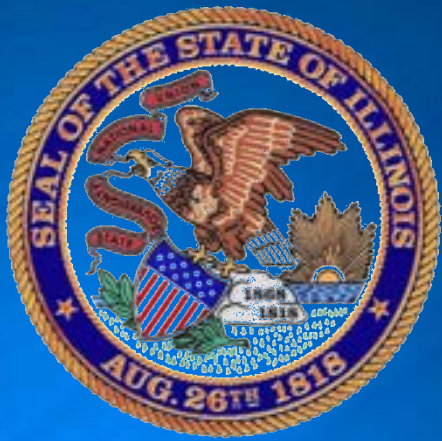


# Pressure Differentials and Radon Entry



Air pressure differentials between the building and outside air causes radon from the soil to be drawn into the house resulting in elevated indoor radon levels.

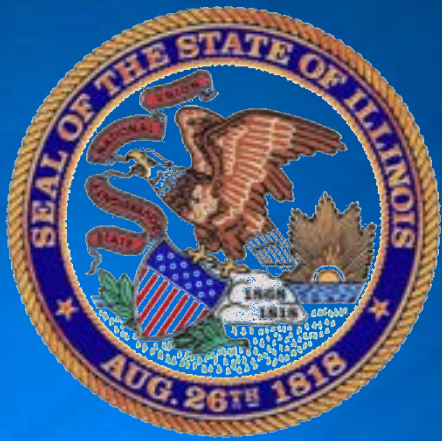




# Mitigation Systems Reduce Radon by:

- Collecting radon prior to its entry into the building and discharging it above the highest eave.
- Modifying building pressure differentials.

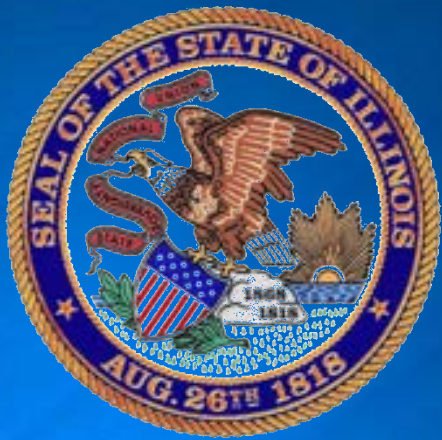




# Common Entry Points

- Foundation Wall Joint
- Crawlspace
- Sump Pits
- Cracks in Floors
- Utility Penetrations





# Active Soil Depressurization

- Active Soil Depressurization uses a fan to draw radon from beneath the house.
- All radon mitigation systems shall be designed to reduce a radon concentration in each area within the footprint of the building as low as reasonably achievable (ALARA).
- Crawl spaces must be included in a radon reduction plan.

State of Illinois  
Paul W. Magowan, Governor  
Illinois Emergency Management Agency  
William C. Burns, Director

### IEMA - Division of Nuclear Safety Radon Program Guide to Radon Mitigation

Your radon concentration is at or above the USEPA's action level of 4 picocuries per liter (pCi/L). What is next?

- Contact a mitigation professional licensed by IEMA-Division of Nuclear Safety to reduce the radon levels in your home.
- Request two or three price estimates from licensed mitigation professionals. The cost of a radon reduction system generally ranges from \$800 to \$1200, depending on characteristics of the house and choice of radon reduction methods.
- Talk to your mitigator and be sure you understand the mitigation design.
- Residents of a dwelling may install a mitigation system in their own dwelling; however, without proper equipment or technical knowledge, you could actually increase your radon level or create other potential hazards.

**IEMA-Division of Nuclear Safety Assures Consumer Protection**

- IEMA-Division of Nuclear Safety-licensed mitigation professionals have passed a radon qualification course and exam.
- IEMA-Division of Nuclear Safety-licensed radon professionals work to a Quality Assurance Program approved by the agency.
- IEMA-Division of Nuclear Safety performs performance audits on a regular basis to evaluate individual professional compliance.

**Mitigation Systems Reduce Radon By:**

- Collecting radon prior to entry into the building and discharging it to a safe location.
- Modifying building pressure differentials.
- Diluting radon concentrations with increased ventilation.

**Mitigation Systems in Illinois Must Include:**

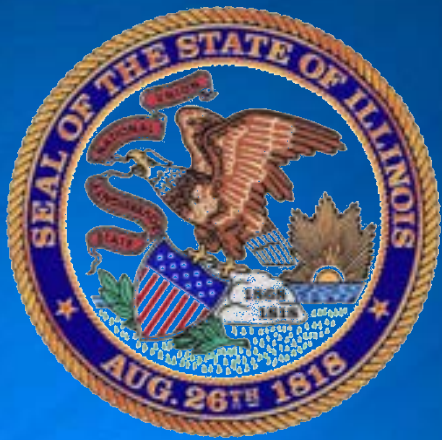
- A system function indicator
- A primary suction point independent of the sump pit
- Sump covers with observation ports
- Exhaust above the highest roof

**Sub-Slab Depressurization (SSD)**  
Active Sub-slab depressurization uses a fan to draw radon from beneath the house. SSD systems collect radon prior to entry and exhaust it to a safe location above the highest roof.

**Sub-Membrane Depressurization (SMD)**  
SMD is performed in crawl spaces and areas that are directly in contact with rock or soil. Suction is created.

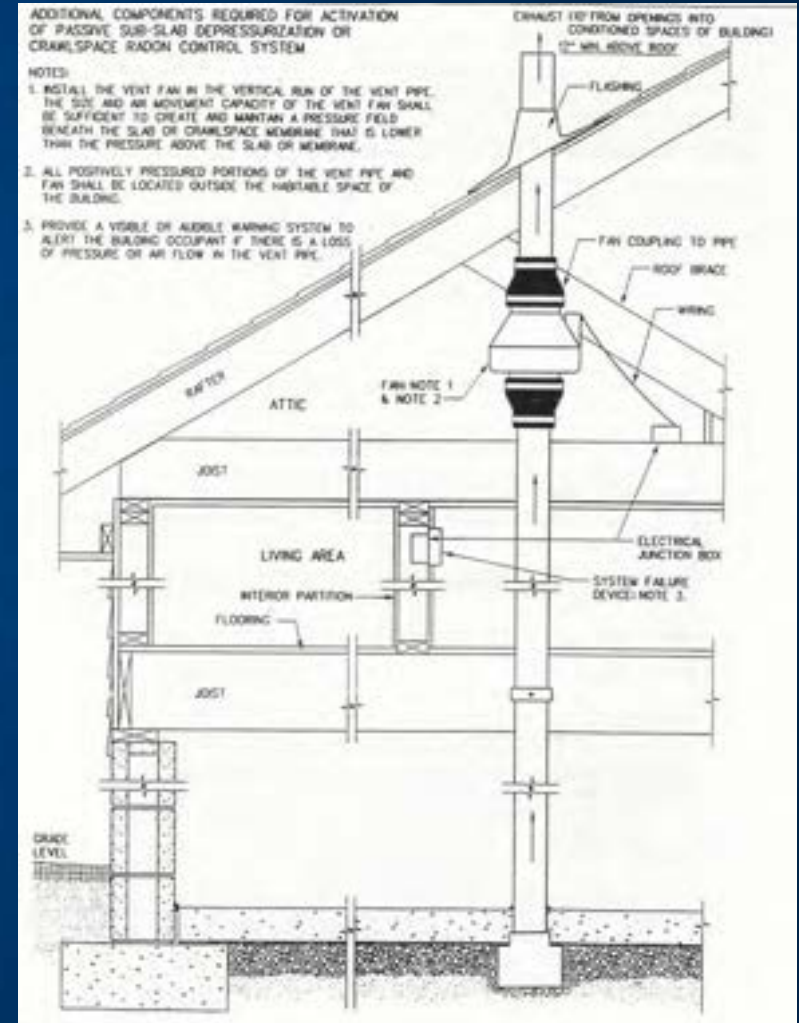
- Under a specified polyethylene or equivalent flexible material (plastic sheet) permanently installed over exposed soil or rock.
- By a fan drawing radon from beneath the plastic sheet and exhausting the radon outdoors above the highest roof.

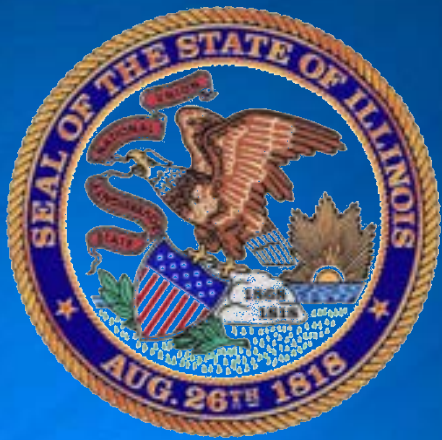
IEMA



# Sub-Slab Depressurization

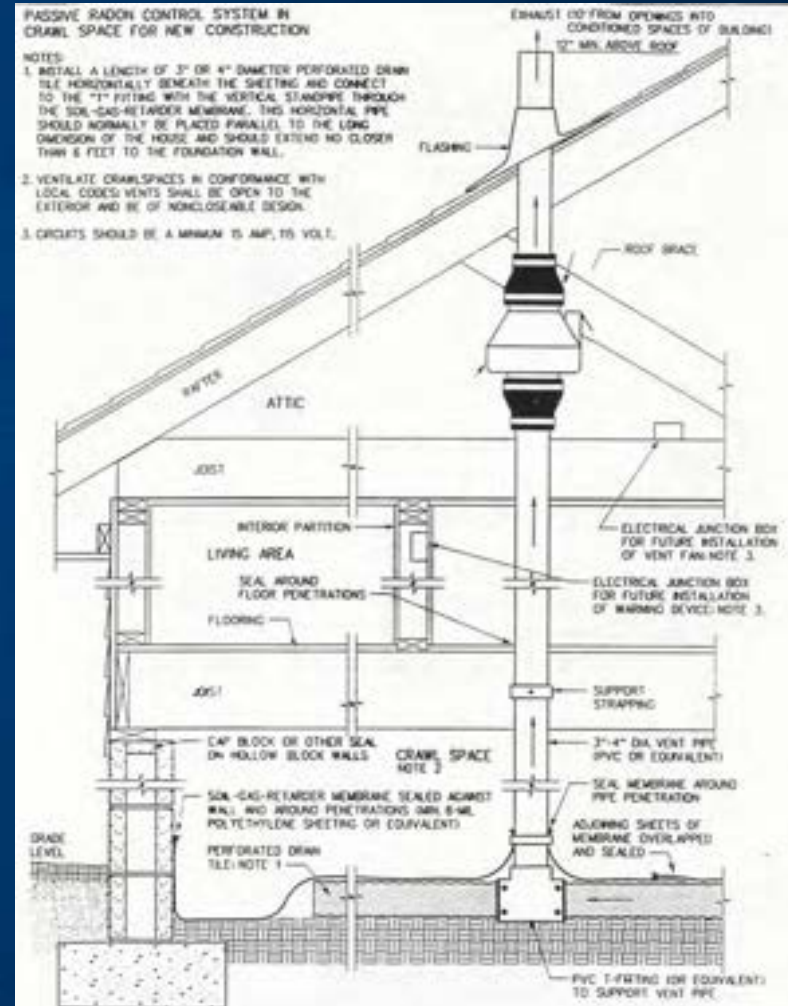
- Sub-Slab Depressurization means a radon control technique designed to achieve lower sub-slab pressure relative to indoor air pressure by use of a fan-powered vent drawing air from beneath the concrete slab.

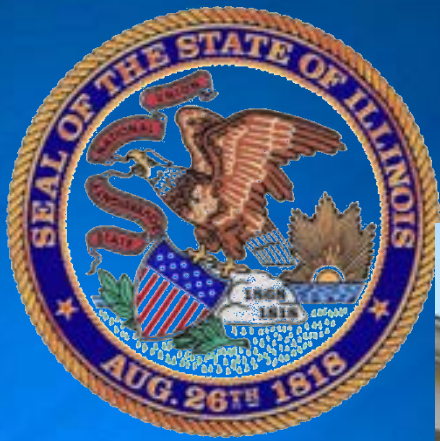




# Sub-Membrane Depressurization

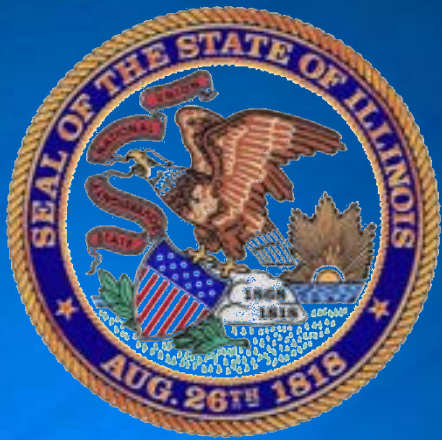
Sub-Membrane Depressurization means a radon control technique designed to achieve lower air pressure in the space under a soil gas retarder membrane laid on the crawlspace floor and sealed, relative to air pressure in the crawlspace, by use of a fan-powered vent drawing air from beneath the membrane.





# Systems on Existing Housing

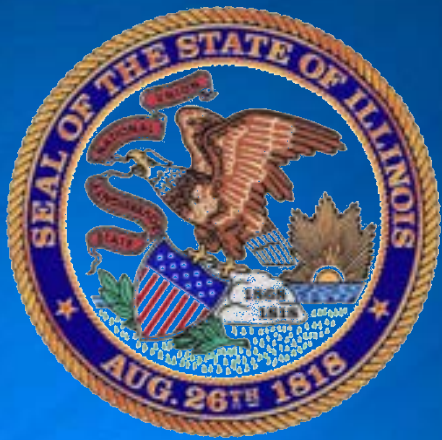




# Radiation Exposure vs. Aesthetics

- Homeowners opt out or decide not to fix the radon problem in their new home because they do not understand the radiation exposure risk.
- They are only concerned with how the exterior of their home looks.



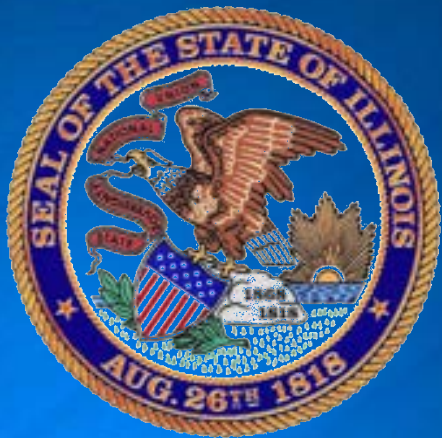


# Illinois Path to a Radon Building Code

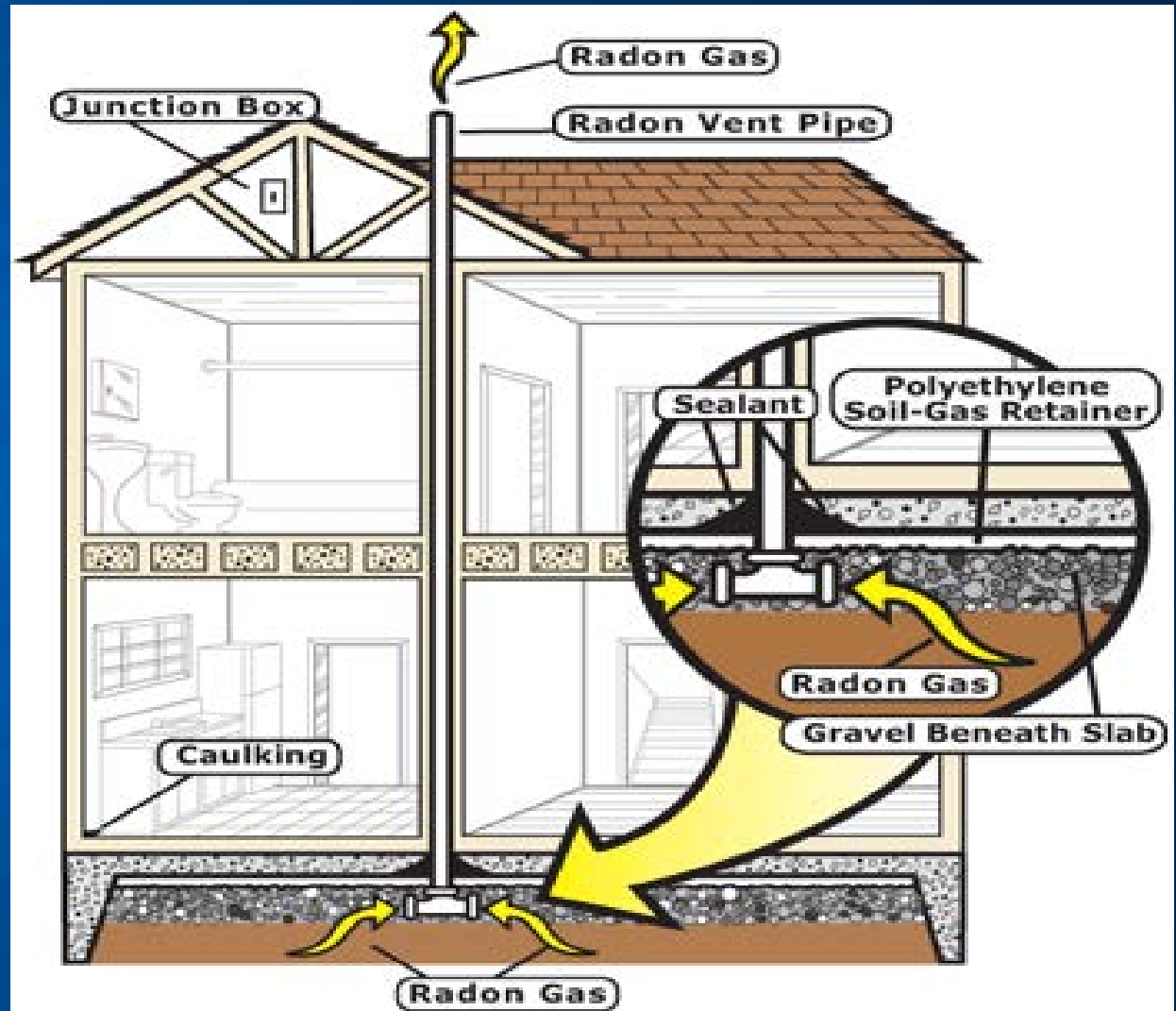
- Illinois Real Estate Attorneys contacted their State Representative concerned about the aesthetics of mitigation systems on new homes.

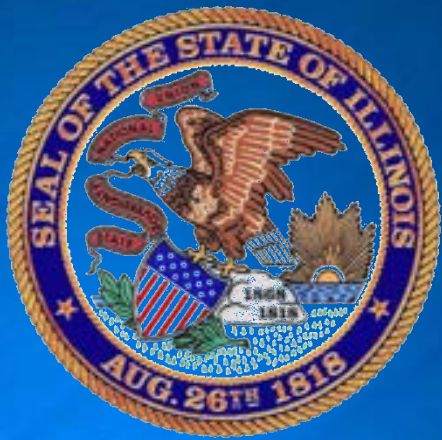






# Unobtrusive and Built In





# Radon Resistant Construction Act 420 ILCS 52

- Effective June 1, 2013, all new residential construction throughout Illinois must include passive radon resistant construction.

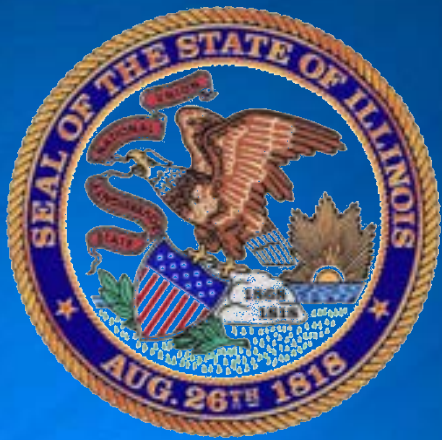
# Cost Comparison



New Home Construction  
\$350 - \$500  
per-home  
(Labor and Materials)

Mitigate Existing Home  
\$800 - \$1,200  
per-home  
(Labor and Materials)

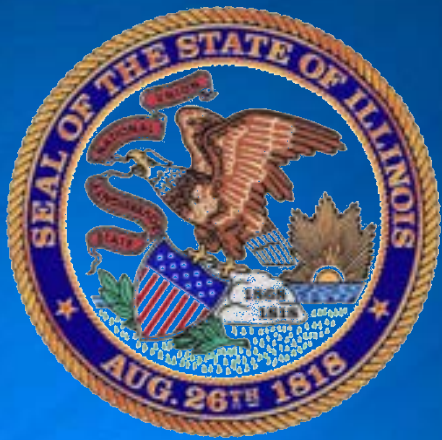




## From the Law

- IEMA shall have primary responsibility for coordination, oversight, and implementation of all State functions in matters concerning the presence, effects, measurement, and mitigation of risks of radon and radon progeny in dwellings and other buildings.
- The Agency shall promulgate rules necessary for the administration and implementation of this Act.



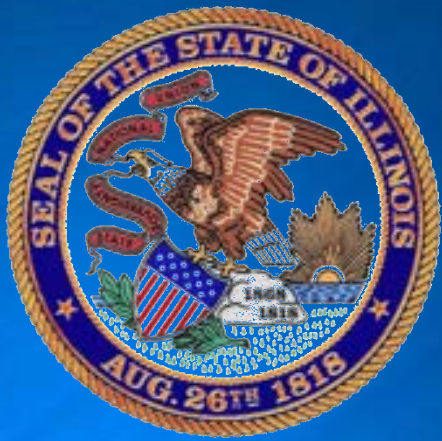


# Revisions to 32 ILAC 422

## Regulations for Radon Service Providers

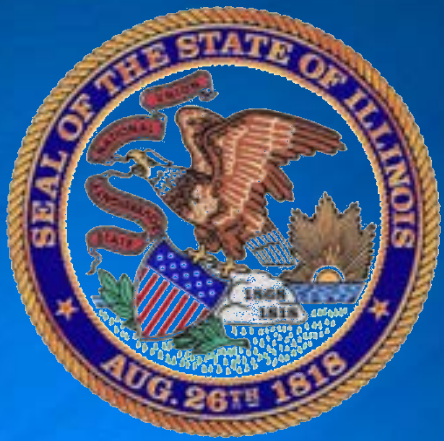
- Regulations are in the review process and expect to be published in the 2013 Illinois Register in November.





# From the Law

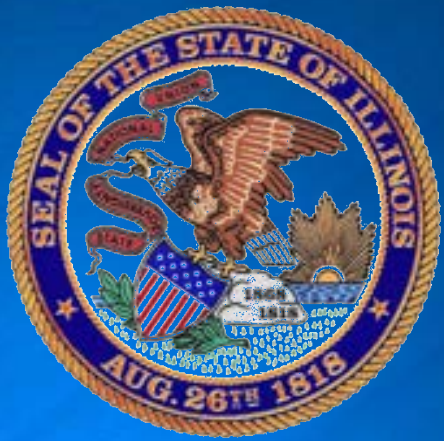
- "Active mitigation system", also known as "active soil depressurization" or "ASD", means a family of radon mitigation systems involving mechanically driven soil depressurization, including sub-slab depressurization (SSD), drain tile depressurization (DTD), block wall depressurization (BWD), and sub-membrane depressurization (SMD).



# From the Law

- "New residential construction" means any original construction of a single-family home or a dwelling containing 2 or fewer apartments, condominiums, or town houses.



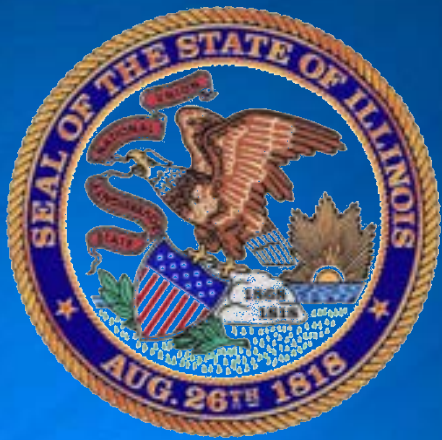


# From the Law

- "Passive new construction pipe" means a pipe installed in new construction that relies solely on the convective flow of air upward for soil gas depressurization and may consist of multiple pipes routed through conditioned space from below the foundation to above the roof.

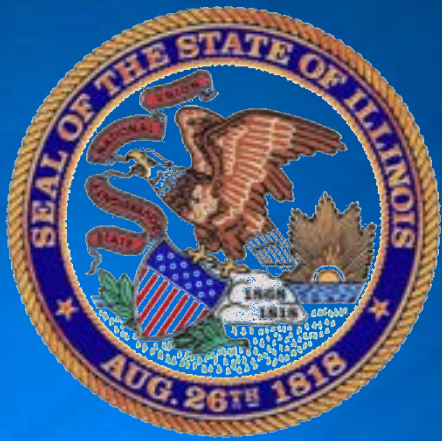






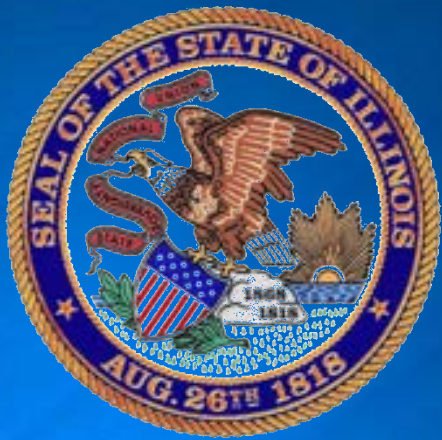
# From the Law

- "Radon contractor" means a person licensed in accordance with the Radon Industry Licensing Act to perform radon or radon progeny mitigation or to perform measurements of radon or radon progeny in an indoor atmosphere.
- "Residential building contractor" means any individual, corporation, or partnership that constructs new residential construction.



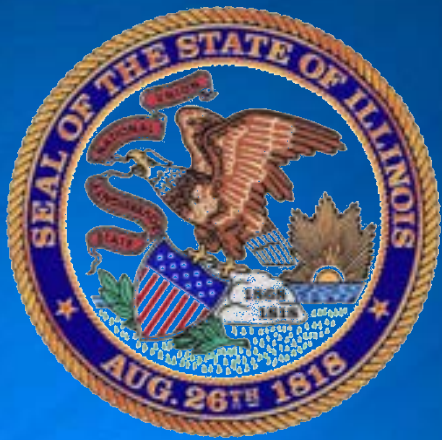
## From the Law

- Installation of active mitigation systems. The installation of an active mitigation system shall only be performed by a radon contractor. The installation of radon resistant construction may be performed by a residential building contractor or his or her subcontractors or a radon contractor during new residential construction. Only a radon contractor may install a radon vent fan or upgrade a passive new construction pipe to an active mitigation system.



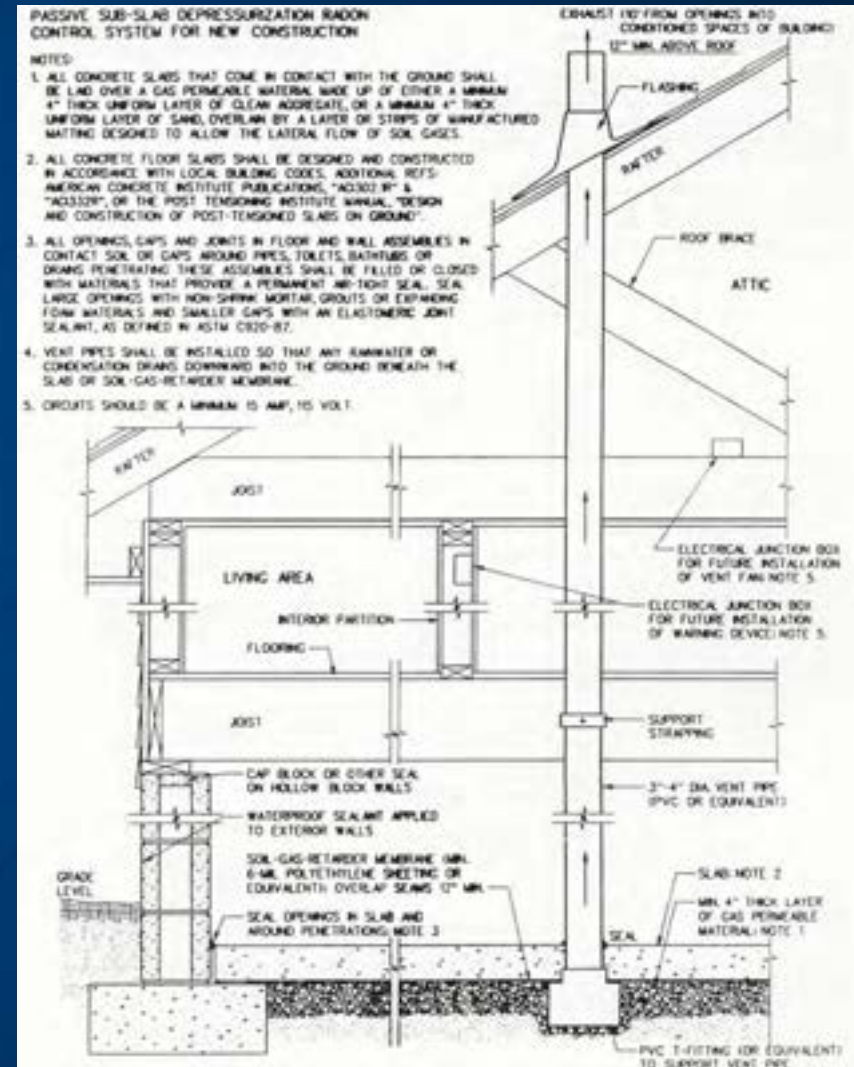
# From the Law

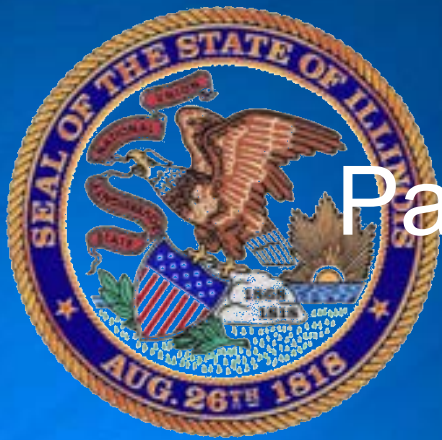
- Local standards. Governmental units may adopt, pursuant to local ordinance, regulations at least as stringent as the rules promulgated by the Agency or may, by ordinance or resolution, adopt the rules promulgated by the Agency for radon resistant construction and the fixtures, materials, and design and installation methods of radon resistant construction systems.



# RRNC System Components

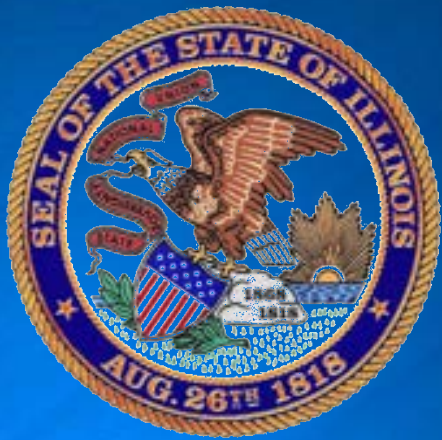
- A passive new construction consists of a vent pipe for a Sub-Slab Depressurization system.
- This system does not use a fan but relies on the convective flow (natural draft) of air upward in the vent pipe.





# Passive System Components

- A Layer of Gas Permeable Material (4 Inches of Gravel)
- Perforated Pipe
- A Minimum of 6 Mil Polyethylene Sheeting or 3 Mil Cross Laminated Polyethylene Sheeting



## Passive components

- Sealing and Caulking All Openings in the Foundation Floor
- Installation of a Minimum 3 Inch Diameter Schedule 40 PVC Pipe
- Roughed in Electrical Junction Box

# Passive Components

- An example of the 6 Mil Polyethylene Sheeting

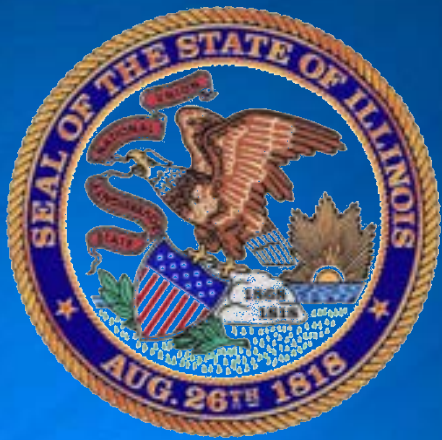


# Passive Components

- Seal and Caulk All Openings in the Foundation Floor.

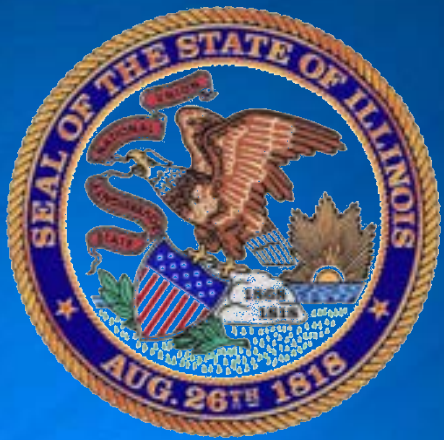






# Radon Systems Must Be Able to Drain

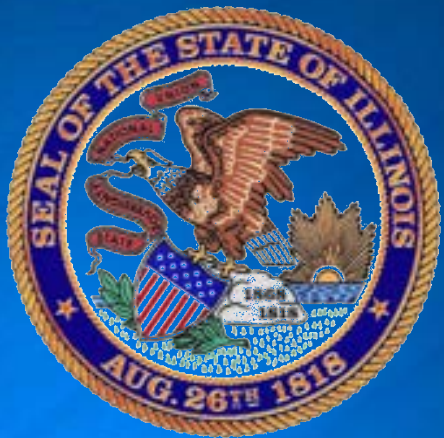
- All radon piping must be sloped to allow drainage.
- Water in radon system is primarily from condensation inside piping.



# Who Can Install an Active System

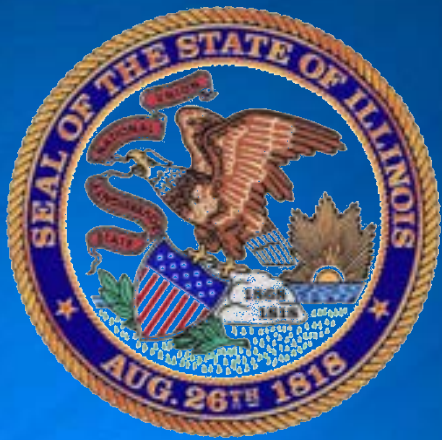
- Only a radon contractor with a license from the Illinois Emergency Management Agency.





# To Ensure Cost Savings to Homeowner

- Allow space for future fan installation in attic or outside habitable space.
- Label vent pipe on each floor and in attic Radon Reduction System.
- To meet the requirements of the law, call a licensed radon mitigator to activate the system.



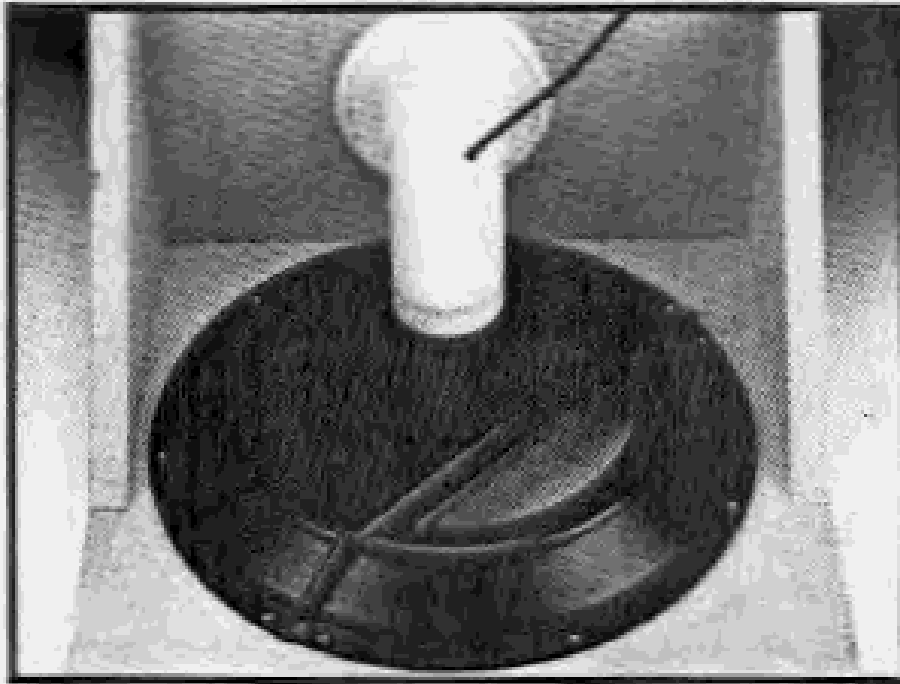
# Radon Exhaust Requirements

- Above the highest eave of the roof and as close to the roof ridge line as possible.
- 10 feet from any window, door or other opening (into the building) that is less than 2 feet below the exhaust point.
- 10 feet or more from any opening into an adjacent building.

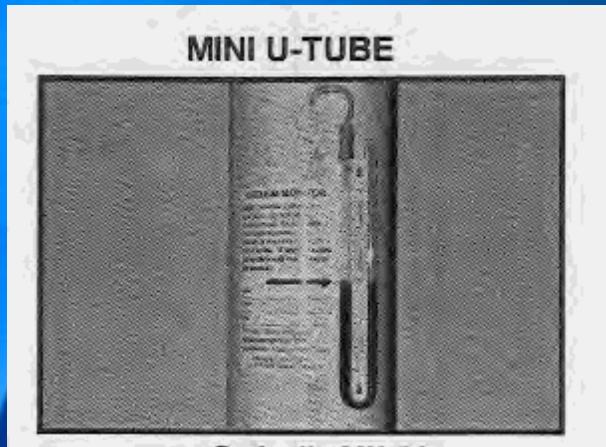
# Typical Fan Designs



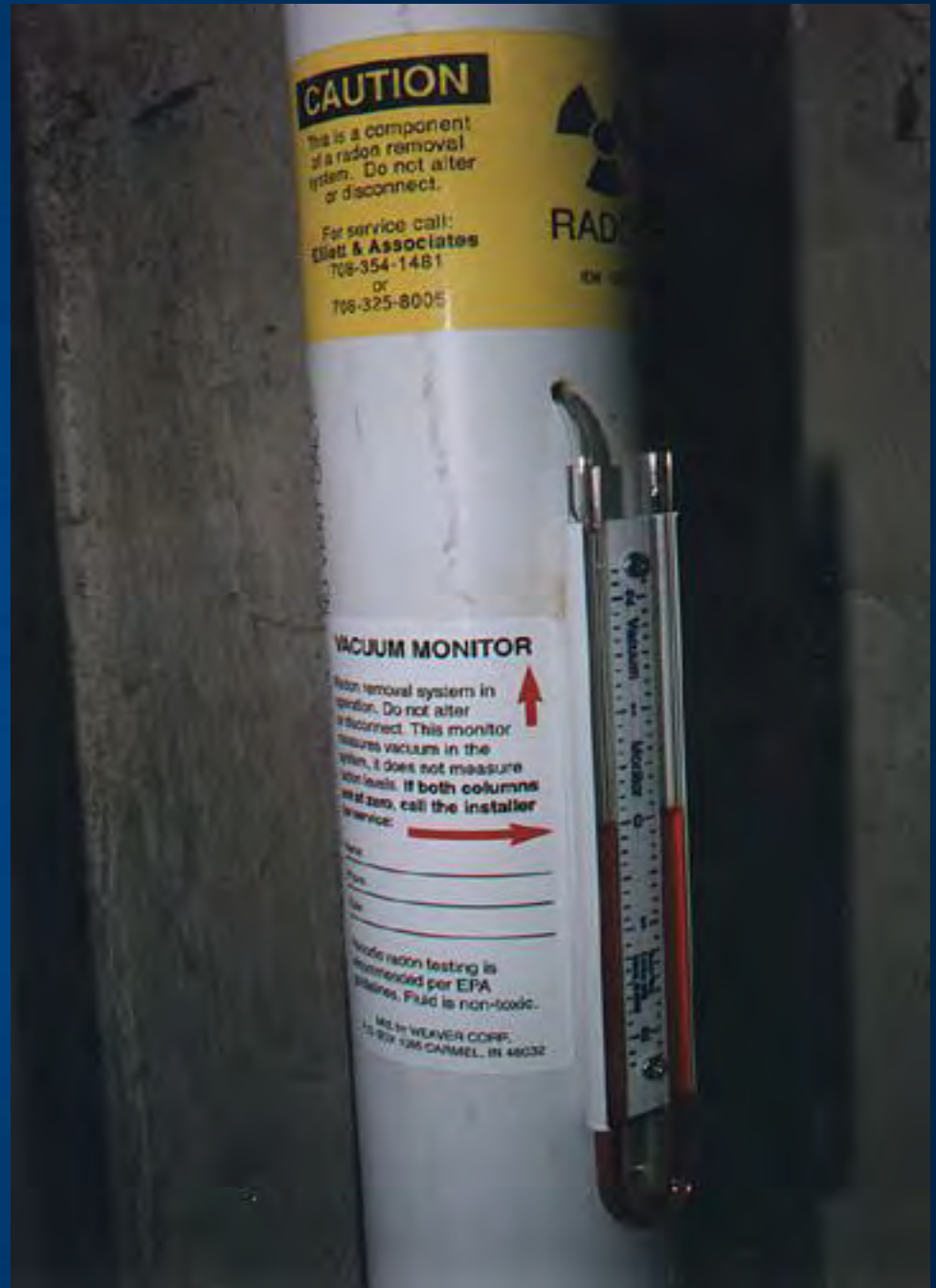
# Sump Pit Cover



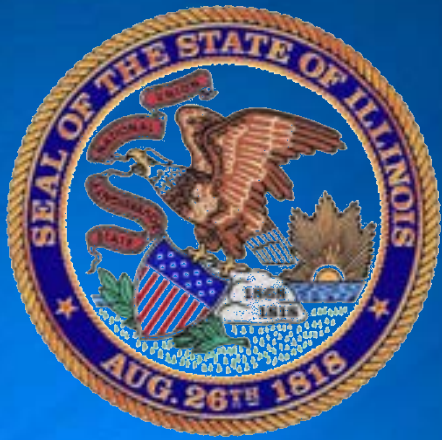
# Typical System Failure Indicators



# Manometer





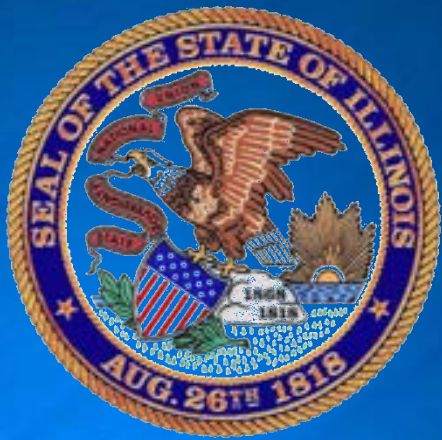


# Sealing Requirements

The following areas require sealing:

- Vent pipe penetrations
- Foundation wall
- Soil gas retarder membranes
- Cracks in slabs
- Other small openings such as utility penetrations

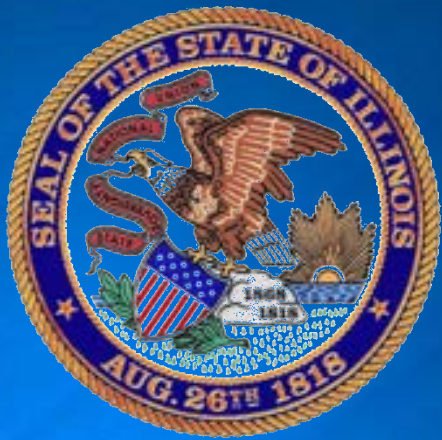




## All Homes Should Be Tested

- All homes should be tested for radon, even those built with radon resistant features.
- Radon resistant homes do not guarantee radon reduction below the action level, only reduce cost and assist with aesthetics.



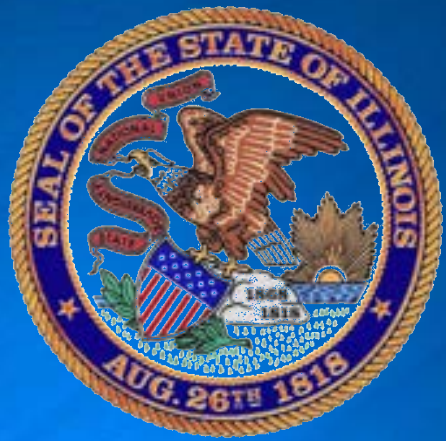


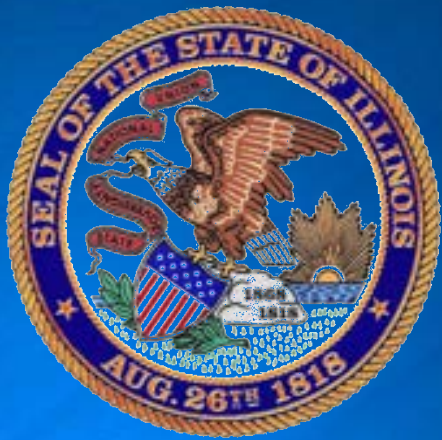
## Upgrading is Easy

- If, after construction is completed, radon levels are at or above 4.0 pCi/L, a Licensed Mitigator can simply activate the system.
- Homes with a passive system can be upgraded to an active system with the simple installation of an in-line fan.



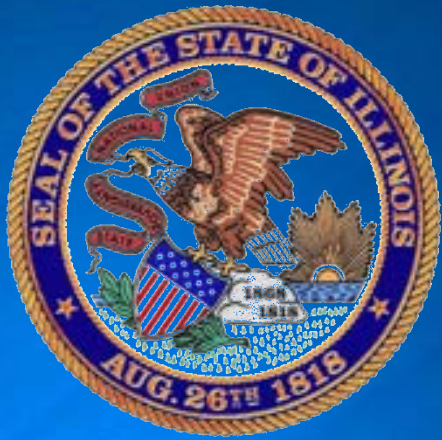






## Post Mitigation Testing

- Once the mitigation system has been activated, a post mitigation test ensures the mitigation system is working as designed!
- Test in the same place as the initial test
- Closed house conditions and other testing protocols should be followed for the post mitigation test as well as the initial test



# Contact Information

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IEMA Radon Program

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[patrick.daniels@illinois.gov](mailto:patrick.daniels@illinois.gov)

